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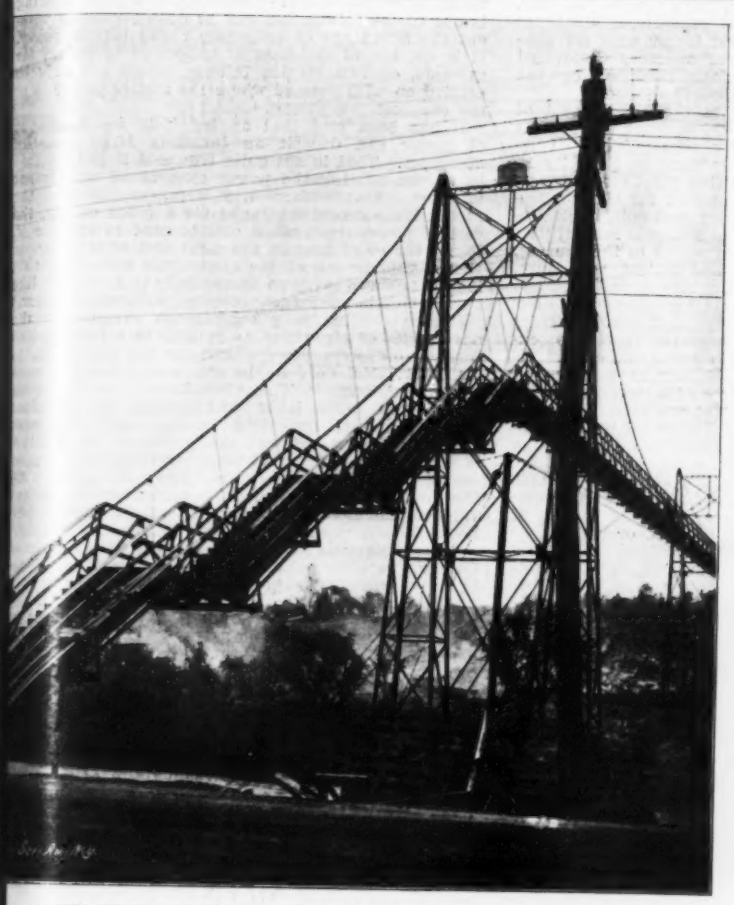
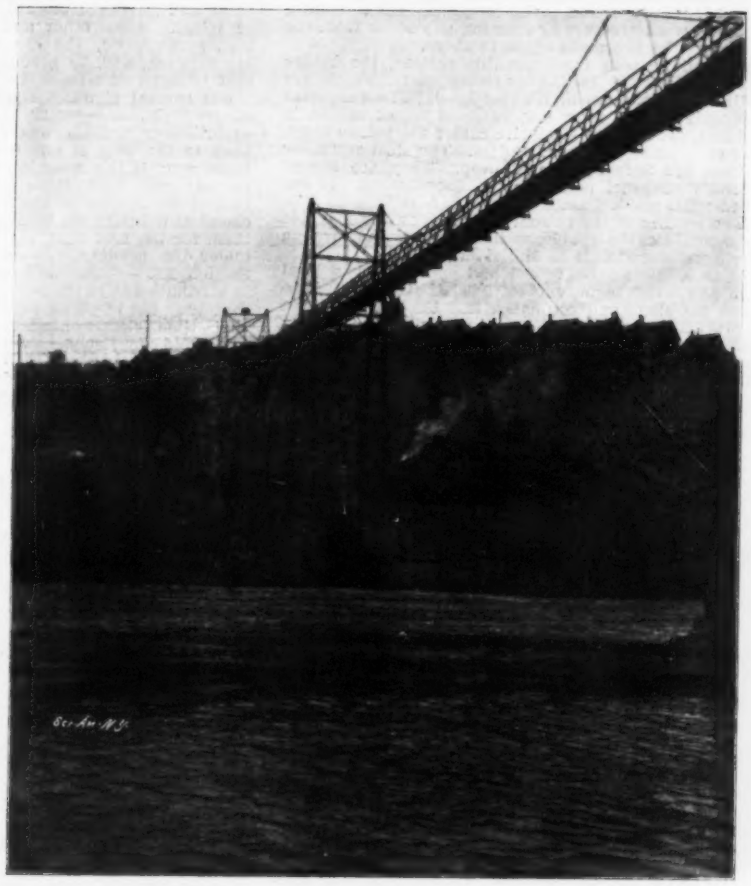


STAIR SPAN OF EASTON, PA., SUSPENSION BRIDGE.



279-FOOT SPAN OF SUSPENSION BRIDGE AT EASTON, PA.

VIEW SHOWING 804-FOOT SUSPENSION BRIDGE AT EASTON, PA.

A CURIOUS SUSPENSION BRIDGE.

By H. G. TYRRELL, C.E.

THE accompanying photographs illustrate a suspension foot bridge just completed at Easton, Pa. It is remarkable in several ways. In the first place, it is built with three towers, thus forming two main river spans instead of one, as is usually the case with suspension bridges. And it is also extraordinary on account of the great difference in elevation of the two ends, which amounts to 90 feet. To overcome this difference in elevation, the floor is run down on a 7 per cent grade from the north bank to the river tower. From this point to the low end are four runs of stairs, the whole being suspended from the cables.

The bridge crosses the Lehigh River, the Lehigh Coal and Navigation Company's canal, and four tracks of the Lehigh Valley Railway. Its total length is 804 feet. It contains two river spans of 279 feet each, and a stair span of 110 feet.

On account of having only a 10-foot roadway, which is small in proportion to its length, it was necessary to resist wind pressure by running guy ropes from the center of the two main spans to shore.

As will be seen from the illustrations, the bridge has steel towers, resting on stone piers, which are built up to extreme high-water level. The height of the center tower, from low water to top of saddle, is 108 feet. It has two steel-wire cables 2⅝ inches diameter each, and ¾-inch suspenders. The steel stiffening trusses are 5 feet 3 inches deep. They are braced laterally at panel points to the floor beams. It has wood joist, plank floor, and wood handrail.

The placing of the masonry anchors on the low side gave considerable trouble, as the water soaked through the loose material from the river.

It is a toll bridge, owned and operated by a local company. In the autumn of 1899 the owners advertised for plans and estimates, and the design shown herewith was accepted. The city engineer of Easton had charge of building the foundation.—For our photographs and the foregoing particulars we are indebted to the Municipal Journal and Engineer.

THE PRESIDENTIAL ADDRESS OF JOSEPH WILSON SWAN, F.R.S., AT THE GLASGOW MEETING OF THE BRITISH ASSOCIATION.

ELECTRO-CHEMICAL INDUSTRY.

THE nineteenth century will be forever memorable for the great scientific discoveries it produced, and the wonderful development that took place during its progress, in the applications of science to industrial uses in relation to chemistry and electricity.

Considering the importance of the subject it seems to me a fitting occasion for passing in brief review the leading events of the century in connection with the rise and progress of electro-chemistry, and for considering its present position and prospects.

The birth of the century was heralded by signs and wonders; the whole horizon of chemical physics was aglow with the light of Volta's great discovery and the constellation of brilliant discoveries it gave rise to. It was in that outburst of new light that the history of electro-chemistry began.

The idea of the correlation of electricity and the energy that determines chemical action was then for the first time grasped; and the prescience of great minds, like that of Davy, led even to an anticipation of that then far distant result, the utilization of electricity as an operative force in chemical industry.*

But the light of that morning glory did not rapidly grow into noonday clearness. Much had to be done before industrial electro-chemistry was possible.

In the first decade the marvelous analytic power of electricity was fully realized, and the idea was generally accepted that electricity was probably of the nature of the force that controls chemical combination. We also then became familiar with those heat-producing effects of the electric current that have only within the lifetime of our society been turned to practical use. The three succeeding decades show no sensational discovery such as made the first decade conspicuous, but they yielded immense product, not only of new knowledge, but many indispensable extensions and developments of what had already been partly attained; above all they produced the work of Faraday, who mapped out and gave a code of laws to the new domain. So far, all the work done was preparatory and scientific, and inspired by the pure and noble aim of the man of science who seeks truth and new knowledge for its own sake. But on the near approach of the fifth decade, the eyes of men of different ideas—practical men—were opened to the advantages of employing the hitherto useless power, electricity, to reach new and useful ends. We all know that the first outcome of this recognition was the origin of that small department of electro-chemical industry to which Smee gave the apt name of electro-metallurgy. So long as this name applied only to the humble but beautiful art of electrotyping, electro-gilding and plating, it seemed pretentious. Smee felt the objection, answered it, and in doing so predicted with rare foresight the future expansion of this field. But, much as he foresaw, it was only the fringe of the wide territory that has since been added.

Faraday had lately discovered and laid down with great exactness most of the governing laws of electro-chemical action—a work of infinite value, essential to progress. But our debt to Faraday, measureless as it was from that great service alone, was further increased by his discovery of magneto-electricity, whereby there was brought within reach a more economical means of generating electricity by the electro-magnetic transformation of motive power. By the employment of this fundamental principle, all the wonderful developments of the use of electricity that we see to-day have been rendered possible.

Historical relics are always interesting, and I feel sure many of you who may visit the Exhibition, will look with interest on one of the exhibits of Messrs. Walker and Hall, an ancient magneto-electric machine used long ago for depositing silver. It is a progenitor of the dynamo that to-day is an essential means of supplying all the great cities of the world with electric light, of working railways, propelling cars through the streets and under them, and of performing a great amount of electro-chemical work.

It is a singular coincidence that the discovery of the magneto-dynamic mode of generating electricity occurred almost at the very moment when several other discoveries and inventions were made which presently called for the assistance of cheaply produced electricity. One of these inventions was submarine telegraphy, with its requirement of large quantities of the purest copper. As I have said, it was in connection with electrotyping and electro-plating that the first industrial application of power-generated electricity was made, and it is equally illustrative of the reciprocal action of demand and supply, that the demand for pure copper, arising out of the use of copper wire for submarine telegraph lines, gave rise to the first large and improved mechanical generators, like those of Wilde. When other and yet larger uses for electricity developed, the electrical engineer discovered his vocation, and, by gradual steps, there was evolved that triumph of science, the modern dynamo.

But several striking events in the development of electro-chemical industry had taken place before that evolutionary process was fully accomplished. I go back to the time of our last meeting in this city 13 years ago; it is a most interesting point of departure. In that year, 1888, those responsible for the publication of the Journal of the Society first paid to electro-chemical industry the homage of sectional recognition; then, for the first time, there appeared in the Journal, under the heading, "Journal and Patent Literature, Section XI."—"Electro-Chemistry and Metallurgy." It is a tribute due to the editor and his colleagues to say that they hit the true psychological moment. Before that time electro-chemical industries certainly existed and flourished—notably electrolytic copper refining—but it is since then that they have grown, in number and variety, to a degree of importance which now requires the most respectful consideration of all who are interested in chemical industrial progress.

Electro-chemical industry depends on the production of chemical effects in a new way; sometimes the effects themselves are new, and not otherwise producible, and in other cases the results are merely improvements on old chemical methods, either in respect of economy or superiority of the product, or both.

Electrotyping and electro-gilding belong to the first class; the results are unique, and constitute valuable additions to the resources of industry and art. Electrolytic copper refining is so great an improvement on the old method, both in point of economy and superiority of product, as to have largely supplanted it, and incidentally to have sensibly raised the value of commercial copper as an electrical conductor.

In another department of electro-chemical industry, manufactures of calcium carbide, of carborundum, and artificial graphite (all new products) have attained large proportions. These depend, as industrial processes, wholly on the high-temperature effects economically obtainable only by means of the electric furnace.

The aluminium and sodium industries have developed into their present large dimensions, solely in consequence of the much greater economy of production of these metals by electrolysis than was ever attained by the old chemical processes. These are a few typical examples of electro-chemical industries, and illustrate the causes of their existence.

In reviewing the salient points of the different sections of electro-chemical industry, I propose first to speak of the electrolytic group of industries, and afterward of that newer group in which not electrolytic action, but the extremely high temperature obtained by the electric furnace is the operative agent. Outside these groups, there is a miscellaneous group to which I must also briefly refer.

Prof. Chandler, in his most interesting and valuable presidential address of last year, gave a large amount of information relating to the progress of electro-chemical industries in America. I shall not repeat what he said, but confine my remarks almost entirely to the developments to be found on this side of the Atlantic.

I have attempted—with, I confess, imperfect success—to obtain authentic information concerning the present position of the electro-chemical and electro metallurgical industries. I have been in communication with every firm I knew of in Europe, applying electricity to the manufacture of chemical and metallurgical products. When I inform you that these firms now number over 150, you will recognize that this new field is being extensively cultivated. The information obtained in answer to a circular letter, issued through the medium of Mr. John B. C. Kershaw, whose valuable assistance I here desire to acknowledge, has been tabulated, and is presented as an appendix. I take this opportunity of also thanking those firms who have placed at my disposal all the information asked, and thus assisted me to the utmost. In many cases figures have been given with the understanding that they shall not be published; hence there are many gaps in my tables. In a number of instances, however, manufacturers have declined to give any information whatever. Of this reticence I make no complaint, for I recognize that it is only natural that those who have acted as pioneers in a new industry and worked out new processes should desire to reap to the full the fruits of their labor. At the same time I cannot but regret that, in consequence, the picture I have to present to you, will here and there be wanting in some of the detail that otherwise I should have been glad to have been able to supply.

COPPER REFINING.

As the senior member of a new industrial line that has won its way to a great and commanding position, the place of honor in my review must be given to electrolytic copper refining. Prof. Chandler, in his address at our last meeting, gave the figures which represent the gigantic copper output of America, and I find that, bringing the production down to 12 months later, there is continued growth.

The total production of raw copper in the year 1900 was 486,084 tons, to which total the United States contributed 268,787 tons. The latest published estimate of the proportions of these totals, refined by the electrolytic methods, gives roughly 172,000 tons for the American refineries* and 37,000 tons for the 27 refineries located in our own country and on the continent. My own inquiries would seem to indicate that the latter estimate is rather too high, and that the European production of electrolytic copper is now less than 37,000 tons a year.

America is by far the largest producer of copper, and, with characteristic thoroughness, she not only produces crude copper, but also refines it. The refining is often carried on in close proximity to the mines, although there is as little tie to a particular locality for an electrolytic copper works, as there can well be in the case of any industry. But if there is water-power conveniently near to the mines, the inducement to finish the work on the spot is sufficiently strong to make it worth doing. Electrolytic copper refining is one of the things that can be done profitably without the advantage of extremely cheap motive power. It is not one of the class of industries to which, for example, calcium carbide belongs, which can only be carried on with success where the motive power is of the cheapest.

It has been said that an infinitely small amount of power can deposit an infinitely large quantity of copper. That is not quite true, but it is true that in copper refining the power element of cost is not vital, and that with skillful arrangements and the use of large depositing tanks for a given output, the cost of power, even when coal is used to produce it, is not the chief item in the total cost of the process. Hence, this is one of the electrolytic industries that it is possible to carry on successfully in a country like ours, which is not largely supplied with water power.

Copper refining is a conspicuous example of the advantages of electricity as applied in a large metallurgical industry. Here electricity has everything in its favor. Not only is the electrolytic process more economical, because it requires little power to be expended and little labor, and because the precious metals found as impurities in the copper are more completely recovered, but the purity of the product is much greater than that resulting from the old process of refining, and when the copper is required for the purpose of an electrical conductor its money value is enhanced in proportion to the increased purity.

In an interesting brochure, entitled "A Century of Copper," recently published, Messrs. Brown and Turnbull give statistical information relating to the growth of the copper industry, and state that at present 300,000 tons, or over 60 per cent of the total output of copper, is utilized in electrical engineering. This demand, it may be noticed, is almost wholly the growth of the last 15 years, and it is rapidly increasing.

Before electrolytic copper refining became general, in the early days of the submarine telegraph, there was a great deficiency in the conductivity of commercial copper. Now copper, for conductors, has almost uniformly the normal conductivity of pure copper, with the result of a saving of at least 10 per cent (arising from the use of electricity in refining) in the quantity of copper used. Besides this saving, there is a much more complete recovery of the precious metals commonly associated with crude copper. The total saving, at a moderate estimate, exceeds £1,500,000 sterling per annum.

It is the common practice to melt up the rough cathodes that come from the depositing vats, in order to cast the metal in the form of ingots, preparatory to its use for the foundry or the rolling mill. This treatment is attended with an appreciable loss of conductivity. To avoid this loss, it has been attempted, with considerable success, to deposit the metals in such forms as to render unnecessary the extra process of fusion. Those who visited the Paris Exhibition last year may have seen some of the results, in the form of large and beautifully smooth tubes and plates shown by the French and German Elmore Companies. The chief hindrance to the direct production of the electrolytic deposits in the finally required form, is the strong tendency of the copper deposited from solutions of the ordinary composition, to be crystalline and rough and deficient in strength. Elmore has met this difficulty by causing the deposit to take place upon a revolving cylindrical surface against which an agate burnisher presses. The burnisher has imparted to it a slowly reciprocating lateral movement, which, combined with the rotatory movement, results in the entire surface of the cylinder being repeatedly traversed while it is receiving the deposit. At the Exhibition there were also some fine tubes shown by Cowper-Cowles, who, in producing them, had employed, not a mechanical rubber, as in the Elmore process, but simply a rapid rotation of the cylinder in the copper solution, and in that way had obtained favorable conditions both of a mechanical and chemical kind. A third method for obtaining sheets and tubes of smooth copper by electrolytic deposition is that known as the Dumoulin process. In this process, specially prepared strips of skin supply the friction necessary for obtaining dense and homogeneous deposits.

From experiments I made many years ago, I ascertained that it was possible, by varying the composition of the depositing solution, to suppress almost completely the common tendency to a strongly crystalline character of deposit, and to obtain a quality of deposited metal comparable to wrought copper in smoothness, hardness, and elasticity. A most remarkable effect in the changed character of the deposit was produced by the addition of a minute proportion of a solution of gelatine in dilute nitric acid, to an ordinary copper sulphate solution composed of a two-thirds saturated solution with 5 per cent of sulphuric acid. If so much of the gelatine solution as represents 1 part of gelatine to 30,000,000 parts of the copper solution be added, instead of the deposit being plant and crystalline, it will, under the proper conditions of temperature and current density, be smooth, bright, and

* In the Bakerian Lecture of 1806 Davy says:—"It is not improbable that the electric decomposition of neutral salts, in different cases, may admit of economical uses."

* Ulke, in a recent article, has "estimated" the U.S.A. production at 211,000 tons per annum.

elastic, and if the gelatine be in excess the deposit will be extremely hard and brittle.

The usual slow rate of electrolytic copper deposition (necessary where the object is pure copper of the highest conductivity) is often a serious limitation to the utility of a most beautiful process. But in those cases where time is of essential importance and where extreme purity is not necessary, the rate can be increased. Where even a ten-fold more rapid rate would be necessary or advantageous, the means certainly exist for obtaining it—of course, not for nothing; the price to be paid is the use of a higher voltage, and therefore, extra power. But considerable gain in speed of deposit can be obtained by taking proper advantage of the help that is given by working at a higher temperature, and employing a highly metallized solution of low specific resistance, coupled with the use of means for obtaining rapid diffusion of the electrolyte at the cathode surface.

Since efficient depositing machines can now be had of almost any size and at a moderate cost—the smaller ones adapted for driving by electric current derived from a general supply, and the larger by independent power—it would not be surprising to find the advantages of electrotyping more widely recognized, and the scope of its operations greatly extended in years to come.

BULLION REFINING.

The principle of the separation and purification of metals by electrolysis, that has been so largely and so successfully employed in copper refining, has been also applied with advantage to the parting of gold and silver, and to the refining of base bullion.

Silver bullion is refined at Frankfort by the Rossler or Gutzkow process, at Pforzheim by the Dietzel process, and at Hamburg by the Moebius process. Nitrate of silver or the corresponding copper salt is used as electrolyte, and the gold is recovered from the slimes by chemical methods.

At Hamburg gold bullion is refined by the Wohlwill process, which depends upon the use of an acid solution of gold chloride. The silver and platinum pass into the anode sludge, and are recovered by chemical methods. The value of these recovered "impurities" helps to pay for the cost of treatment, and, in particular cases, more than covers it.

Bullion refining by electrolytic methods is finding extensive use in America, and at the Guggenheim Refinery at Perth-Amboy a plant for refining silver by the Moebius process, having a capacity of 100,000 ounces of silver per day, has recently been put in operation.

ELECTROPLATING.

It is an interesting point in connection with the rise of electroplating, the oldest but one of electro-chemical industries, that it was to meet its requirements that mechanically produced electric current was first industrially employed. The magneto-electric machine was patented by Woolrich in 1842, and the first machine built was used by Prime, of Birmingham, for electro-plating. At the Exhibition in Kelvingrove there are two exhibits in this class well worth inspection; one, that of Messrs. Walker and Hall, where the old magneto-electric machine I have spoken of is to be seen; and the other, that of Messrs. Elkington, who, 60 years ago, obtained a patent for electroplating and gilding by means of cyanide of potassium solutions of gold and silver. During all the progress of later years in other branches of electro-chemical industry, there has been little or no change in this. The solutions as patented by Elkington are identical with those in general use at the present day.

ZINC AND NICKEL PLATING.

An important development in the application of the principle of electroplating, is its use for the purpose of giving to an inferior metal a protective coating of a harder or less oxidizable metal, other than gold or silver. The most noteworthy instances of this kind are the galvanic coating of iron with zinc; of copper with a thin protective film of iron, industrially known as "steel facing;" and the plating of iron and other metals with nickel. So-called galvanized iron is, as we all know, a misnomer; there is nothing more galvanic about it than there is in coating iron with tin by dipping it in a bath of fused metal. But there is a true galvanic zincing process, which is used to a limited extent in coating boiler tubes; the advantage claimed over the dipping method is that the physical properties of the iron are less altered. The deposition of iron on copper is mainly employed for preventing the wear of engraved copper plates. The steely hardness of the thin coating which is nearly pure iron, except for occluded hydrogen, is very remarkable. The plating of small articles with nickel has now grown into a considerable industry, chiefly owing to the requirements of the cycle trade and the demand for nickel-plated accessories. Electrolytic coatings of cobalt, platinum, and palladium have also been quite successfully applied to other metals as protective coatings, but, so far, no great use has been found for them. Perhaps one of the most notable of these outlying examples is that of the deposition of palladium on the electrotype concave mirrors made for projectors by Cowper-Cowles, in order to improve and preserve the refining surface.

ALUMINIUM.

I now enter a different and a wider field—that of the extraction of metals from their ores—a field in which successful work was only possible after the dynamo was well developed, because the consideration of extremely cheap power is much more pressing in this case than in copper refining, or any other of those cases in which the same metal is dissolved at one pole and deposited at the other. For the moment interest chiefly centers in aluminium and sodium. Both these metals had been for many years produced in considerable quantities by purely chemical means—the method of Deville in the case of aluminium, and that of Castner in the case of sodium—but the commercial results were such that the market price of aluminium never reached a lower point than 16s. per pound. A revolutionary change was brought about through the successful working out of electrolytic processes by Hall in America, and Heroult in France, each working independently of the other. The Hall process was clearly described by Prof. Chandler in his address last year. The process of Heroult is similar. Some little difference there may be in the electrolytic bath and in the form of the apparatus, but substantially they are one and the same. These processes have now been in successful operation for 11 years, and the results are, the total extinction of the chemical method, and the reduction of the selling price of aluminium to between 1 shilling and 1 shilling 6 pence per pound. This great reduction in the price of aluminium has led to the creation of a new and large metallurgical industry, by which a most valuable addition is made to the common metals. The production of last year has been estimated at about 6,000 tons. This is divided between Europe and America in the proportion of two to one.

Before passing from the subject of aluminium I may refer briefly to its most important uses. First, we have the use of aluminium in the iron and steel foundry. The addition of a small amount of aluminium, or of an aluminium alloy, the moment before casting, serves to remove any oxygen the melted metal may hold in combination, and consequently to increase the fluidity of the metal to be cast. The heat of combination, moreover, is sufficiently great to sensibly raise the temperature of the melted metal. I am unable to give figures showing the amount of aluminium used for this purpose, but it is undoubtedly one of the chief outlets for the metal at present. Probably the next most important use of aluminium is as an electrical conductor in lieu of copper. This application of aluminium has hitherto been chiefly confined to America, and our friends across the Atlantic have shown their confidence in the durability of the new metal, by erecting several hundreds of miles of bare aluminium overhead transmission lines. Whether aluminium will prove as resistant to atmospheric corrosion as copper, time alone will show. Experimental trials of aluminium for similar purposes have also been made on this side of the Atlantic, but so far the results are not decisive. In the Glasgow Exhibition you will find an example of this use of aluminium, for the overhead wiring of the outside arc-light installation has been undertaken by the British Aluminium Company with metal made at Foyers.

This rivalry between aluminium and copper, even if it be only a limited rivalry, may prove a salutary check on the price of copper.

Limits of time forbid mention of all the various other uses that have been found for aluminium, which result in the consumption of more than 20 tons a day of what was an expensive metal, before it became the product of an electro-chemical process. I am told that a large proportion of this huge quantity is used in the manufacture of small articles, such as cooking pans, drinking cups, water bottles, scientific instruments, and innumerable nicknacks of various kinds. Aluminium bronze and aluminium brass and similar alloys are also applications of importance, and absorb a considerable quantity of the metal.

Through cheap aluminium and the Goldschmidt process, the engineer becomes possessed of a means of producing, in an easy and convenient way, an extremely high temperature, applicable to the welding of iron. The chemist and metallurgist are already busy utilizing the same means for the reduction of the oxides of the more fusible metals, and the formation of their alloys, in accordance with the original proposal of Vautin. Particularly useful members of this class are chromium and ferrochromium. I trust that ere long new and still more important uses will be discovered for aluminium.

SODIUM AND MAGNESIUM.

The electrolytic extraction of sodium is so closely related to that of aluminium, that the few observations I have to make on it may be fitly made here.

The sodium industry affords another instance of the displacement of an old and purely chemical process by an electrolytic one. The change has been brought about on the sole ground of the greater economy of the electrolytic method.

The discovery of sodium recalls a memorable episode in chemical history that links past and present closely together, for the Royal Institution, where we held our meeting last year, is the birthplace of sodium. There, 94 years ago, in the Albemarle Street cellar, where, as of old, ambitious research is still carried on as actively and enthusiastically as ever, sodium first put off its rusty vesture, and in silvery splendor mirrored the eager face of Davy.

The principle of Castner's sodium process is exactly like Davy's—both are electrolytic, and in both the electrolyte is fused sodium hydrate. The apparatus as patented is simple. An iron pan with a fire under it contains the fused sodium hydrate. The cathode passes up into this vessel through an opening in its base, and both it and the annular anode which surrounds its upper portion are, I believe, formed of nickel. A strong current is employed, which helps to keep up the temperature of the electrolyte to fusion point. The sodium is released as liquid metal, and rises to the surface of the fused soda, means being taken to remove it and to prevent its combustion on coming in contact with the air.

By this process sodium is now manufactured by hundreds of tons, and passes into commerce partly in metallic form chiefly for use in the cyanide manufacture, but a considerable portion is converted into peroxide of sodium. The total output in 1897 was 260 tons. The Castner sodium process is operated at Weston Point; at Rheinfelden; and at Niagara. Electrolytic processes are also in use at Bellegarde; at Bitterfeld; at Hochst, near Frankfort; and at Neuhausen. It is worthy of remark that in England the electricity employed in the process is generated by steam power. In this manufacture advantage is taken of the exceptional purity of the soda produced by the Castner-Kellner alkali process.

The consideration of the methods by which sodium is produced naturally leads me to speak of the sister metal, magnesium. In the extraction of magnesium also, the electrolytic method has superseded the chemical method. The process is analogous to that used for the extraction of sodium. The electrolyte is fused carnalite. The magnesium industry is small, no large use for the metal having yet been found—and the only factory known to me is that at Hemelingen in Germany. Quite lately a promising alloy of aluminium and magnesium (called "magnalium"), said to have excellent qualities, has been attracting attention.

ZINC, COPPER, AND NICKEL EXTRACTION PROCESSES.

Before I pass from this section I ought to mention some of the numerous other attempts that have been made to apply electrolysis to the extraction of metals from their ores, and particularly I ought to mention the electrolytic extraction of zinc. Zinc ore has been the subject of innumerable essays, almost all of them failures, from a commercial point of view. But I am informed that a process of electrolytic zinc extraction, in which chlorine as well as zinc is produced, is in successful operation at Winnington. This process is based on the patents of Hoepfner, and a considerable quantity of extremely pure zinc is the result. Specimens of this zinc, by far the purest commercial zinc ever made, testing 99.96 per cent, are shown by Messrs. Brunner, Mond & Co. at the Exhibition.

* * * * * * * *

The problem of the recovery of the metals contained in the mixed sulphide ores of the Broken Hill district of New South Wales has exercised the skill and ingenuity of many chemists—a full description of the various processes tried would itself occupy more than the time at my disposal to-day.

In this field electrolytic methods have not, it must be confessed, met with the success that was at one time hoped.

The Swinburne-Ashcroft process is still in the experimental stage of development. Many modifications in the original method have been made, and that now being tried consists, I am told, in the mixture of the pulverized ore with fused zinc chloride, in the removal of the silver and lead after chlorination by chemical substitution, and in electrolysis of the molten mass, containing only zinc chloride.

The attempts to apply electrolytic methods in the extraction of other metals directly from their ores have nowhere as yet achieved distinct success. Both copper and nickel ores have been the subjects of many experiments, and in some cases large installations of plant have been put down and operated. In the '80's the Siemens & Halske, and Marchese, methods for treating copper ores received industrial trial; I believe without permanent success. More recently the Hoepfner processes have been the subject of similar large scale tests in Germany; and in America there has been considerable activity in connection with processes for nickel extraction at Niagara, and at Sault Ste. Marie. I have been unable to ascertain the commercial results of these recent industrial trials.

The Hoepfner process for treating nickel-copper ores and residues is operating at Papenburg in Germany. The production toward the end of 1900 was stated to be at the rate of one ton of nickel per day. I am not aware of the existence of any other nickel works in Europe using this process; but electrolytic nickel is said to be produced by two firms using methods similar to those employed in copper refining, i. e., using anodes of raw nickel.

Dr. Mond has estimated that the total consumption of nickel is now 9,000 tons per annum, and the new Clydach works in South Wales, where his most beautiful nickel-carbonyl extraction process is about to be worked, are designed to produce 1,500 tons of nickel per annum. Nickel may therefore now be regarded as one of the common metals.

GOLD RECOVERY FROM CYANIDE SOLUTIONS.

On the border of the field of electrolytic metal extraction, we find in successful operation a process for the recovery of gold from the weak cyanide solutions yielded by the treatment of the tailings and slimes of the Rand goldfield. The process is that of Messrs. Siemens & Halske. An extremely weak electric current is used, and the gold is deposited as a brown coating on thin lead cathodes. When the gold deposit has sufficiently accumulated the cathodes are exchanged for new plates, the gold-coated plates being melted, and the gold recovered by cupellation.

The lamentable war in South Africa has caused the suspension of all mining operations for nearly two years, and consequently no very recent statistics of this process are available. On January 1, 1898, it was stated that 13 works in the Rand district were using Siemens & Halske's process, and that 12 others were about to adopt it. Pauli, in the same year, estimated that 88,000 tons of tailings, and 46,000 tons of slimes, were being treated monthly by this process. But improvements in the older zinc process, which are said to have made it the equal of the electrolytic process for treating very dilute cyanide solutions of gold, had been made shortly before the war broke out. The first cost of the plant for the improved zinc method of treatment is considerably less than that required for an electrolytic plant, and therefore the limits of expansion for the electrolytic process may probably have been reached. The costs of operating the two processes were given by Yates in 1897 as 3 shillings 2 pence for the electrolytic, and 2 shillings 6 pence for the zinc process per ton of tailings, but the modified zinc process costs rather more than the original one; and the cost of treatment (neglecting interest on capital outlay) is now, I believe, about equal.

Before leaving the subject of gold recovery I may refer to the Riecken process, now being tried on a large scale in Western Australia. In this process the finely divided ore is agitated with a solution of sodium chloride containing potassium cyanide, and during agitation the mixture is electrolyzed, with amalgamated copper plates as cathodes and carbon anodes. The mechanical difficulties involved in this method of treatment are obvious.

THE ELECTROLYTIC ALKALI AND CHLORINE INDUSTRY.

I now pass on to speak of the electrolytic alkali and chlorine industry, embracing the production of caustic and carbonated alkali, and of bleaching powder, hypochlorites, and chlorates.

For obtaining chlorine and sodium, or chlorine and soda, no process can, theoretically considered, be more beautifully simple and complete than the electrolysis of chloride of sodium. But when an attempt is made to carry out this form of decomposition on an indus-

trial scale, a number of perplexing practical difficulties present themselves.

If, with a view to obtain a high yield from a small plant, the chloride is used in the state of fusion, then the selection of a suitable material for the electrolytic cell, and the separation of the electrolytic products, both at a high temperature, are found to be matters of serious difficulty.

Numerous attempts have nevertheless been made to overcome these obstacles, and two processes, namely, that of Hulin and that of Ackers, have attained industrial trial in France and America respectively.

The Hulin process has not yet achieved financial success, and modifications of the original process are now, I understand, being introduced. The Ackers process is more recent, and, though now in operation at Niagara, its ultimate value is uncertain.

Greater success has attended the employment of aqueous solutions of common salt, as the electrolyte, for the production of alkalies and bleach. The electrolytic decomposition of brine, or of potassium chloride solutions, has already attained the rank of a stable and successful industry. The forms of apparatus employed have not yet settled down to a uniformity of type, such as obtains in the competing chemical processes; and there is much obscurity concerning details of the processes employed at several of the continental electrolytic alkali works.

I may, however, state that there are two well-marked types of cell employed in the electrolysis of brine for production of alkalies and chlorine. One is the type in which mercury is used to amalgamate with and separate the sodium or potassium set free at the cathode, and to remove it from the area of electrolytic or chemical reactions within the primary cell. In the other type of cell a diaphragm is used to divide the anode and cathode compartments, and the chemical reaction, by which the metal is transformed into the hydrate, is, as far as possible, restricted to the cathode compartment.

With respect to the first type of cell, two forms are in actual use, and are working with satisfactory results, namely, the Castner-Kellner and the Solvay cells. The former is operated at Weston Point, at Osternienberg, and at Niagara; while the latter is stated to be in use at Jeneppe, in Belgium, and at Donetz, in Russia. The process worked out by the "Elektron" Company, of Frankfort, and now operated in a large number of electrolytic alkali works in Germany, France, Switzerland and Russia, is stated to be a diaphragm process; but this company refuses to give any information upon this point, and the above statement is only conjectural. The Castner-Kellner and the Solvay cells have so often been described in print, that it is unnecessary for me to repeat the description. Through the courtesy of the directors of the Castner-Kellner Company I have been permitted to visit their works at Weston Point. There I saw in full operation a chemical works employing 4,000 horse power and yielding a large output of very pure soda and very strong bleaching powder, and also a large quantity of sodium and its products, without creating any kind of nuisance. There were, it is true, four tall chimneys, but these were almost smokeless. The ashes from the engine furnace and a little thin smoke from the chimneys were the sole products in the nature of refuse. The solid contents of the brine, brought into the works by a pipe from the neighboring salt beds, were wholly transformed by steam power into valuable products. The bleaching powder plant covered two acres. I believe it is the largest in the world. The cleanliness and regular working of an electrolytic alkali process are not unimportant points in its favor.

Turning now to a consideration of the industrial position of the diaphragm type of cell, I find that three modifications of it are in actual use.

One of the best known of this type of cell is that devised by Hargreaves and Bird, and described in great detail by Mr. Hargreaves before the London Section of this society in December, 1895.

The success of an experimental plant which was worked for six years at Farnworth has led to the erection of a large factory at Middlewich, in Cheshire. On the occasion of a recent visit to these works, the building of which is not yet completed, I saw a double series of 11 large cells in operation, each cell taking an E.M.F. of nearly 5 volts and a current of 2,000 to 2,500 amperes.

The higher E.M.F. required per cell than that given by Mr. Hargreaves in his original paper, is stated to be due to the use of thicker diaphragms. The product here is not caustic, but carbonate of soda, and bleaching powder.

Asbestos, and Portland cement rendered porous by the admixture of various salts during setting and subsequent lixiviation, have both been successfully employed as the material for the diaphragms.

Other diaphragm processes in actual operation are the Outhenin Chalandre and Le Sueur processes. The first is worked at Chevres, near Geneva, and at Montiers, in France; while the second is operated at a paper mill near Berlin Falls, New York.

The Outhenin-Chalandre cell consists of a bell-shaped anode chamber of suitable material, into the sides of which a large number of porous tubes are fixed in a position slightly inclined from the horizontal. The tubes act as diaphragms, and contain the sheet iron cathodes. The caustic soda solution formed at the cathodes passes to the lower ends of the tubes, and then collects at the bottom of the cell by gravity.

The Le Sueur cell contains a horizontal diaphragm, with the anode compartment on the upper side. According to Weightman, the diaphragms are of asbestos, and last from three to six weeks. Each cell takes 800 amperes at 6 volts and has a current efficiency of 70 to 80 per cent.

Although the principle of cell construction in which gravity is allowed to effect the separation of the sodium hydrate formed at the cathode, and in which therefore a diaphragm, or mercury is dispensed with, has been discredited by the failure of the Richardson and Holland process at St. Helens, yet a cell on that principle is said to be working with satisfactory results at Aussig, in Austria, and, according to Hausserman, this works is producing alkalies and bleach at the rate of 2,640 tons per annum.

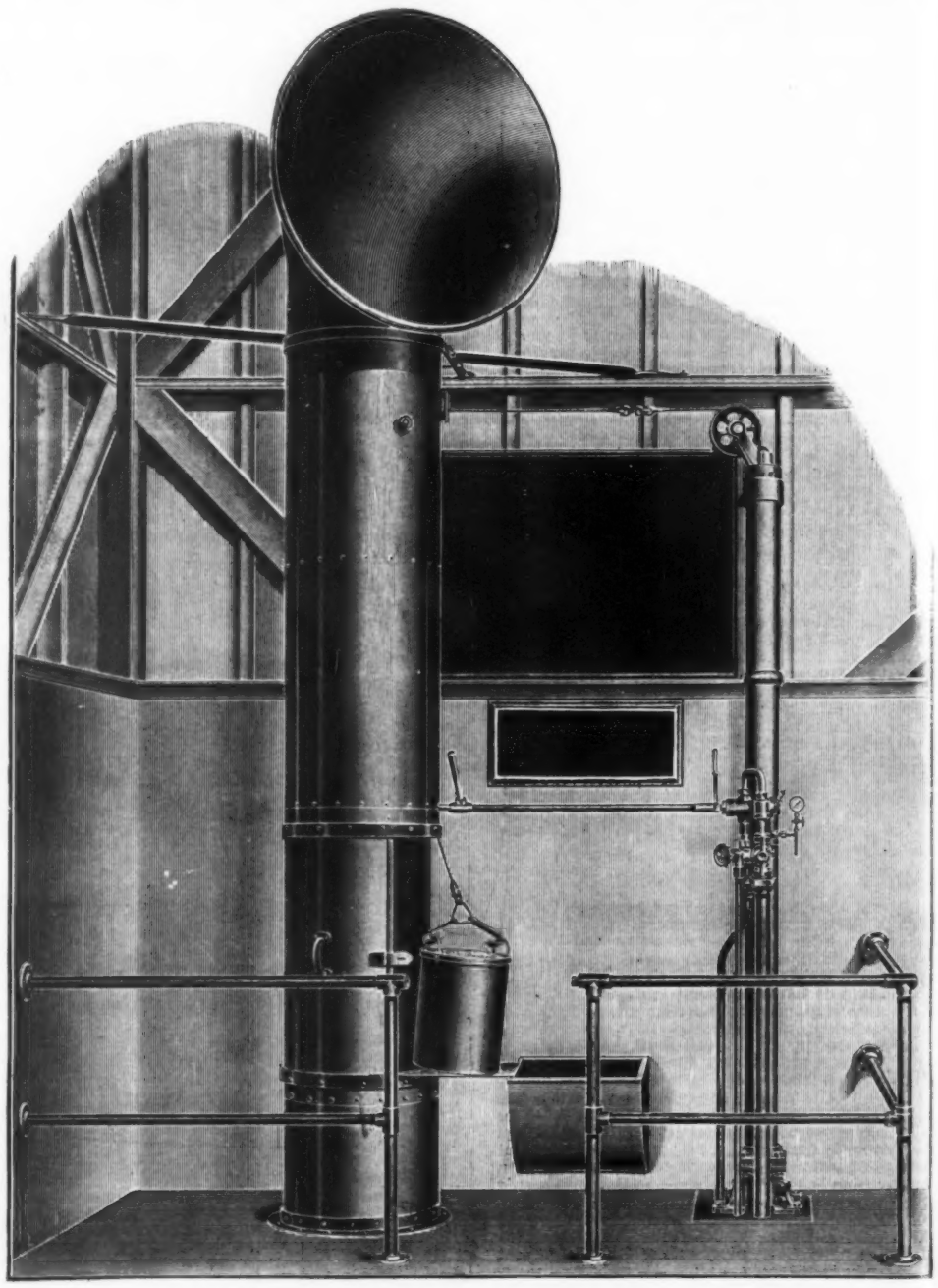
A recent laboratory research by Adolph has shown that, under carefully regulated conditions, a current efficiency of over 80 per cent can be attained in these cells with continuous work; and, as the saving in cell construction and E.M.F. is considerable, it is possible that "gravity" cells may once again come into use.

There are now 23 electrolytic alkali works in operation in Europe, disposing in the aggregate of 50,000 horse power. I have figures in my possession for the production of many of these works, but in some cases I am not allowed to make use of them for publication.

(To be continued.)

THE CROMPTON ASH HOIST.

THE accompanying illustration shows the latest design of the Crompton ash hoist, which has been brought out by the patentee, Mr. T. Albert Crompton, M.I.N.A., consulting engineer, 86 Leadenhall Street, London, E. C. The work of hoisting ashes by hand labor from the stokehold of steamers was very fatiguing, and was formerly performed by the stokers, frequently under very trying circumstances. The Crompton ash hoist was designed to remedy the former difficulties. It works silently and without trouble.



VIEW OF THE CROMPTON ASH HOIST AT THE BOILER POWER HOUSE, GLASGOW EXHIBITION.

The system upon which this hoist works is as follows: An eighth turn of the operating handle admits steam to the air extractor through the combination cock, and at the same time opens up a communication direct to the bottom side of the piston in the tube, when a powerful vacuum is instantly formed in the tube, and the atmospheric pressure, acting on the top side of the piston, forces it down, and the ashes receptacle ascends the ventilator, reaching the door as the piston arrives at the bottom of the tube, the whole operation being quickly and silently performed. A quarter turn backward of the operating handle destroys the vacuum, and the empty bucket then descends. The machine can be bolted up in any position on shipboard. In many of the vessels fitted the area of the base occupied is less than one square foot. When at sea all steam is shut off and the connections to the main condenser opened, a condition which greatly reduces the working cost.

The Crompton ash hoist is erected in the boiler power house at the Machinery Hall, Glasgow Exhibition, where it is at work daily, lifting all the ashes from the boiler installation of the stokehold floor to an overhead platform, where they are then discharged through a trunk shute into railway wagons outside the building.

These ash hoists are being adopted for other work than on steamships, such as electric lighting stations, breweries, and coal hulks for coaling ships, where the weights are heavier and a larger diameter of tube is used.—The Steamship.

THE UTILIZATION OF BLAST FURNACE GASES.

AT a recent meeting of the German Association of Iron and Steel Makers, an important paper was presented by Herr Lürmann on recent developments in the utilization of blast furnace gases. From this and from the discussions, which are very fully reported in Stahl und Eisen, we obtain many interesting particulars as to the work done in this direction in Germany and elsewhere, and its extent and importance.

As regards the progress made during the last three years Germany, with Luxemburg and Belgium, heads the list. The following figures represent the power developed with engines at work or in hand in April, 1901. Germany now employs 58 per cent of the total power, 9,900 H. P. generated in Simplex engines supplied by the Cockerill Works at Seraing in Belgium, and affiliated firms; 10,120 H. P. in Deutz engines; 12,800 H. P. in Oechelhaüser two-cycle engines from the Deutsche Kraft Gesellschaft; 6,740 H. P. from the Nürnberger Maschinen Fabrik, and 5,105 H. P. from Körting engines, making the large total of 44,665 H. P. There are 7,600 H. P. in Belgium, 7,400 H. P. in France, and 1,800 H. P. in Italy now furnished by Simplex engines from the Seraing and associated firms. Luxemburg, one of the pioneers of this industry, has at Differdingen and Dudelingen 6,600 H. P. in Simplex engines from Seraing, and 3,200 H. P. from the Deutz-Otto firm, or a total of 9,800 H. P. In Russia there are two Seraing engines of 700 H. P. at Toula, as well as three Oechelhaüser engines, giving an aggregate of 1,500 H. P. at Kamenskoje, and a 30 H. P. Deutz engine; total, 2,230 H. P. In England and in Spain respectively only 600 H. P. are developed from Simplex engines, and these two countries stand last on the list. The total power in Europe is 77,545 H. P. In the United States nothing has been done in this

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direction, which is a surprise to German engineers, who have considered this country as always ready to lead in improvement.

As to the kind of engines used, three of the chief German firms supply gas engines for blast-furnace gases, the Gas Motoren Fabrik Deutz, who make the well-known Otto engines; the Deutsche Kraft Gesellschaft, at Berlin, makers of the Oechelhaüser two-cycle engine; and Körting Brothers, at Hanover, who build four and two-cycle engines for this class of work. All these motors have been repeatedly described. The arrangement of the cylinders may be tandem or side-by-side, and usually all the pistons, up to four, or even eight, work upon the same crank shaft. The Deutz firm has not made engines of more than 300 H. P. per cylinder; a four-cylinder engine would thus give 1,200 H. P. They have constructed 18 engines, with an aggregate of 5,900 H. P., and have 13 more, developing 7,450 H. P., in hand. At Dudelingen there are two 600 H. P. Deutz engines, and one of 1,000 H. P. The Société Cockerill builds four-cycle engines of the Simplex type, developing 600 H. P. per cylinder; four of these would thus give an aggregate of 2,400 H. P., and 36,000 H. P. are now at work, or in course of construction. The Oechelhaüser two-cycle engines give 300 H. P., and up to 1,000 H. P. per cylinder; two would thus yield 2,000 H. P. with only two cylinders. Three of 1,800 H. P. are already at work, and 18, giving a total of 14,500 H. P., in course of construction. The Körting firm has made the two-cycle single-cylinder double-acting engine up to 500 H. P.; seven are now in hand, developing altogether 4,250 H. P., and among these there are two double-acting two-cycle engines with two cylinders, each giving 1,000 H. P.

Herr Lürmann, who has made the most careful study of this question, considers that after all the most important point—which was at first hardly considered at all—is the purification of the gases. Not only is this required for the proper working of the large gas engines, but it has also been proved that a smaller quantity of the purified gas is needed for the hot-blast stoves, thus leaving more available for power. As the operation of the blast by gas engines has proved entirely satisfactory, it is necessary to use very little gas under boilers for raising steam, and a larger proportion can be utilized in the engines. According to Herr Lürmann's calculations, based on the results of actual experience, the power which can be generated through gas engines directly is 3.6 times greater than that made available by burning the gas under boilers to raise steam; a gain, the amount of which can readily be appreciated. In German practice the consumption of gas in the gas engine cylinders has been from 2.5 to 3.5 cubic meters per H. P. hour; and on this basis the available surplus per ton of pig iron made is from 12.5 to 28 H. P.

From experience obtained at Differdingen and elsewhere Herr Lürmann considers that the fan form of purifier is by far the best, and experiments have made it possible to determine a form which seems to give most satisfactory results. In all the arrangements hitherto made for cleansing blast furnace gases, one of the main difficulties has been the immense volume of gas to be purified and cooled, and consequently the large dimensions and high cost of the purifiers. Assuming that each ton of iron treated yields 4,500 cubic meters of gas, and that a furnace deals with 300 tons of pig iron per day, we get 1,350,000 cubic meters of gas per 24 hours, or 1,000 cubic meters per minute. Such a quantity can easily be managed in a fan. A liquid resembling thin whitewash flowed from the discharge pipes of the fan at Differdingen. This was the fine dust, and was run off into a clearing tank, of which there were three. Each held 60 cubic meters, and was sufficient to receive the liquid dust from gases feeding five to seven gas engines, each developing 600 H. P. After the dust has deposited in these tanks, they are flushed with water, and the dust carried away. If one fan is not sufficient to purify the gases a second may be added.

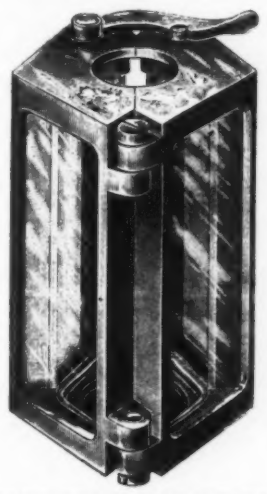
The fan used at Differdingen, being originally intended for other purposes, was not provided with the junctions at the side necessary to connect it to the gas pipe. Fans designed for this special object are very strongly constructed, and may also be cooled with water if desired. They are made single or double, to draw in air on one or both sides. The single section fan is coupled to an electromotor on the same foundation. The fans so far used are in two sizes, with vanes of 29½ inches and of 59 inches in diameter. The sections of the admission and discharge openings are very large. In the single fans they correspond with the smaller-sized vanes to a width of pipe of 16 inches; in the larger size to one 31 inches in width. With gases at a temperature of 122 deg. the fans can produce a pressure of 12 inches of water, the smaller-sized fan making 1,600 revolutions and the larger 800 revolutions per minute; if the temperature is higher, the pressure is less. The quantity of gas treated was 150 to 1,000 cubic meters per minute; power required to drive the fan without water, 15 to 90 brake horse power; weight of the single fan, from 750 kilogrammes to 5 tons. With double fans the breadth of the vanes can be twice that of the single fans at the same speed and pressure; the power required and developed is about double, while the weight is only half as much again. The choice of a fan, therefore, will depend on whether it is to be connected to the gas pipe by one or by two pipes.

Whether it is advisable to use smaller fans or exhausters, with a diameter of the vanes of, say, 60 inches, running at 800 revolutions per minute, treating 1,000 cubic meters of gas, and requiring 90 H. P. to drive them without water; or to use very large fans running at 138 to 170 revolutions per minute, requiring from 150 to 270 H. P., and treating 5,000 to 6,000 cubic meters of gas per minute, experience is needed to decide. In both kinds of fan complete purification of the gases from dust and steam is obtained, if the water is admitted simultaneously, by the perfect mixing of the gas and water, and the constant whirling motion of the vanes. More power will be required if water is added than if air only passes through the fan. But if the question of cleaning the gases is once satisfactorily settled, there will be plenty of power to spare in blast furnaces, and no better utilization of it could be desired than that of purifying and cooling the gases.

So large a gain, as is shown by the statements given above, is well worth consideration, and it is somewhat surprising that no experiments have been made in this country in the direction of utilizing the waste gas. While our practice differs from the German in many points, especially as our ores are generally higher in iron than those used in Germany, so that the fuel consumed and the quantity of gas generated are less while a much larger proportion of the gas is used in heating the blast, the existence of a considerable surplus still seems probable. It is certainly large enough to make an appreciable economy possible through its utilization; and it would seem to be of importance to our ironmakers to ascertain how great that saving might be.—The Engineering and Mining Journal.

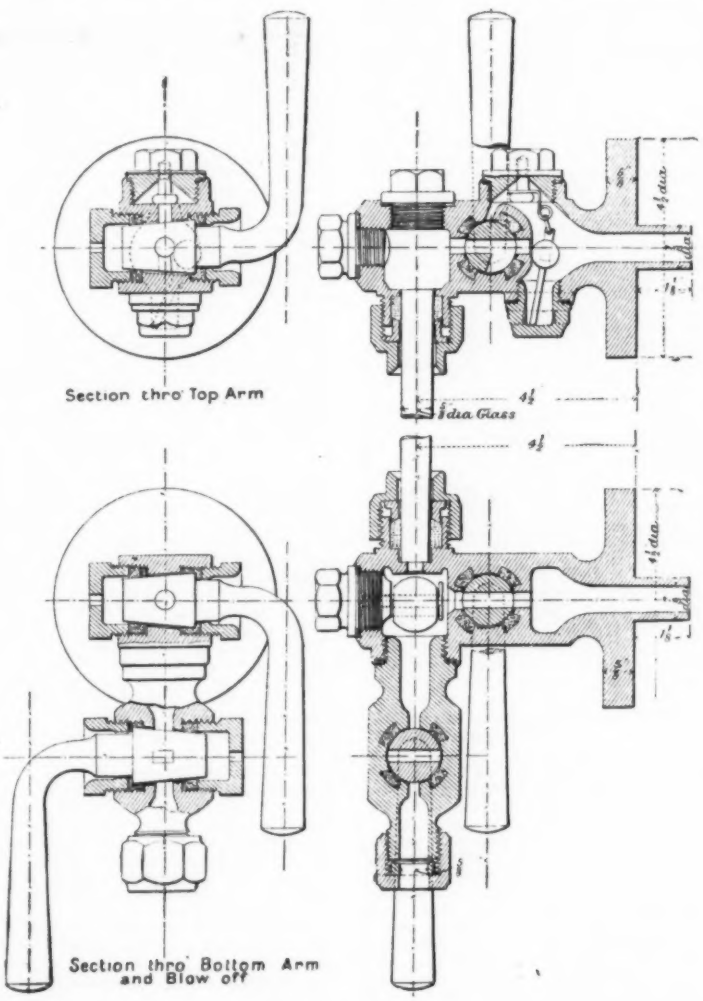
LOCOMOTIVE WATER GAGE.

THE water gage of which sections are given herewith appears to fulfill the various qualifications which



GAGE GLASS PROTECTOR.

are demanded in a good gage. Most important of these is, perhaps, the provision of facilities for cleaning, so that there may be no temptation to neglect that operation. The gage shown is of the pattern fitted on Midland locomotives. A very similar, but longer, gage is made for land boilers. The drawing is practically self-explanatory, but a few words are necessary. The upper and lower plugs or cocks are packed with segmental strips of a composition of rubber and asbestos, which forms a hard, polished, steam-tight surface. The plug bears only on these, being clear of the surrounding metal. This is shown more clearly in the cross section. The safety arrangements to prevent escape of steam in the event of a glass breaking are different top and bottom. In the former it consists of a brass bead threaded freely on the upper part of a short rod, which is supported by a link from the cap. In the event of a glass breaking, the rush of steam carries the ball against the opening and stops the flow. The end view shows the position of the parts better, and makes it clear that a free passage is left for driving a pricker through the plug into the boiler to clean out the ports. At the bottom end the ball is much larger and is immediately below the glass. It fits very loosely on a spindle screwed into a plug, and is lifted vertically by the rush of steam. In neither are there any loose parts. To provide for the case when it is desired to blow through the glass—the lower cock between the boiler and the glass being closed, and that to the drain open—a passage is cut in the upper cock in such a way that, when the handle is hanging downward, there is a passage to the tube via the upper route shown. When the handle is placed horizontally the steam is cut off. These gages, which are made by Charles Winn & Company, of Birmingham, have, as Mr. Johnson expresses it, plenty of "timber" in them. It might be mentioned that the glasses are provided with a new form of plate-glass protector, as shown in the accompanying cut. It has four windows, and almost incloses the glass. It can be at once put on or taken off, and the glasses removed or replaced without the use of a single tool.—For our engravings and the foregoing particulars we are indebted to The Engineer.



DETAILS OF WATER GAGE.

AMERICAN LOCOMOTIVES IN ENGLAND.—IV.

By A LOCOMOTIVE ENGINEER.

IN the following remarks I purpose dealing with the more general question of the structural differences between American and English locomotives in their bearing on the suitability of each for railways abroad, and in respect of the influence they exert on the competition between British and American engine makers in neutral markets.

It is a branch of the subject somewhat extraneous to that of "American Locomotives in England," but, on the one hand, it was pointedly alluded to by the chairman of the Midland Railway Company in his remarks to the representative of The Daily Mail when speaking of the inferior performance of the American engines on the Midland line; and, on the other hand, it holds a prominent place in Mr. Rous-Marten's article in the columns of The Engineer under the above heading. I think, therefore, that criticisms on his article would not be complete without my dealing with it.

It is a many-sided question of much interest to locomotive men, not alone from what may be called the scientific or structural point of view, but in its commercial aspect, as affecting the pockets of locomotive users on the one hand, and of British and American locomotive makers on the other. With the question of its bearing on the pockets of the users of American locomotives in this country I have already dealt rather fully, but what I have said on this point is open to more general application, as will presently be seen.

But, by way of preface, I would remark that, in the various controversies that have sprung up from time to time on the vexed question of American *vs.* British

locomotives, the subject has not, to my knowledge, received the full and exhaustive treatment which is necessary to make clear the fundamental principles which underlie and govern the general design and structural details of locomotives which are distinctive in the practice of English and American locomotive makers respectively. Each system has its merits and its drawbacks, dependent largely on the conditions of working. Which of the two holds the balance in the eye of the purchaser depends on the point of view from which he regards the question. My desire in what follows will be to put the case as fairly as possible as between one system and the other from an all-round point of view.

As a preliminary to getting a proper grasp of the question at issue, it is necessary to have a clear conception of what is meant by "American" and "English" locomotives. In answering this question I feel I lay myself open to criticism, because my experience tells me that there are almost as many different ideas on the subject as there are locomotive men. I proceed, nevertheless, to state, as a result of a long and intimate knowledge of both makes of engines, what the distinctive features of each are, taking the American engine first. Disregarding for the moment the contour and external appearance of the American engine, which is in marked contrast with the more symmetrical and simpler looking outline of an English engine, although it is not without its significance, and will be touched upon later, the one fundamental feature of the American design is the bar frame. It is sometimes spoken of as if it were an original American invention. The younger generation of locomotive men at home and abroad may perhaps be excused for thinking so, because the plate frame has been so long established—for half a century or more—in British locomotive designs, that anything different is naturally looked upon as modern.

No one, however, knows better than the well-informed American locomotive man that the bar frame is merely a survival of the old original locomotive frame adopted by Bury in his early designs, as exemplified in the engine "Liverpool" designed by him in 1834 for the Leicester & Swannington Railway, a form of frame which was abandoned in favor of the plate frame as soon as the rolling of plates of sufficient dimensions for the purpose was established in this country. Its continued use in America long after its abandonment in this country is to be accounted for by the then inability of American rolling mills to produce suitable plates. In the meantime the bar frame took such a hold in American locomotive designs—the cylinder attachments being incorporated therewith—as to result in a set practice which has been adhered to to the present day, notwithstanding the ability of American plate-makers to produce now plates suitable for locomotive frames. Bar frames have, doubtless, some advantage in lending themselves readily to the attaching of outside cylinders to one another as well as to themselves, and there may be other minor advantages not so readily discernible, but they are purchased at a serious loss in the sacrifice of from 5 to 6 inches in the width of the firebox and grate—a matter, no doubt, of little consequence when locomotives were small, but of very material import in these days of enormous engines for gages of 4 feet 8½ inches and downward, seeing that any cramping in the width of the firegrate means a proportionate lengthening thereof, with all the well-known disadvantages which accrue after reaching a certain length—a length which has long since been exceeded in the majority of engines for all gages up to and including the 4 foot 8½ inch, which constitute by far the greatest number throughout the world.

Having made a present of the bar frame to American locomotive makers, what is there left in respect of general design which can be regarded as fundamental, or which the British locomotive maker is precluded from adopting if the conditions under which the engines are to work admittedly require it, or the purchaser considers it necessary to specify? I shall proceed by a process of elimination, and we shall then see what remains special or peculiar to the American engine. I may say, in the first place, that I am not now alluding to minor details which influence first cost, durability, and upkeep. Nor do I refer to the nature and quality of the materials employed in the respective parts of the engines, and largely affecting first cost—although I will deal with both of the forenamed matters in due course—because it is obvious that any material that can be used with satisfactory results by American locomotive makers can be equally well employed by English manufacturers. What I had in mind was, rather, such questions as outside *vs.* inside cylinders. The practice in America is, as we all know, almost universally in favor of outside cylinders, but this cannot be claimed as a distinctive feature of American engines, seeing that at least 50 per cent of British made engines have also outside cylinders. This being so, whenever locomotive users prefer outside cylinders, English makers are in a position to accommodate them. If, again, the roadway is such as to require a certain specified limit of weight per axle, English locomotive makers can employ the necessary number of axles to insure this just as well as American engine makers. Furthermore, they can couple them together or leave them uncoupled, or can apply bogies at front or at rear to give the required flexibility on crooked roads just as well as Americans. If, on the other hand, balance beams are necessary in any case to enable the engines to travel over badly constructed or badly maintained lines, there is nothing to hinder English locomotive makers from using them, as, in fact, they now do whenever the conditions seem to require them. But having had long personal experience of locomotive running on good roads as well as on bad roads, with all classes and makes of engines—both American and British—with outside cylinders and with inside cylinders, with bogies and without bogies, on straight lines and on curved lines, and lastly, with balance beams and without balance beams, I may, perhaps, be permitted to point out to the inexperienced railwayman—whether he be a director, or a minister for railways, or even a locomotive engineer, for all locomotive superintendents have not had the opportunity of this experience—that balance beams, and bogies too, if they are given too free side play are not unmixed blessings. Balance beams and bogies may be essential to the safe running of an engine on a weak, crooked and badly laid roadway—such as is usually found in outlying districts of newly developed countries, as yet too poor to afford anything better, and to which American-made engines seem usually to find their way—but on such lines as these the pace is necessarily slow, as a consequence of their bad condition, quite apart from the fact that high speeds are not looked for or required on such lines, time being of less value than in more developed districts. It may be noted in passing, no one appreciates balance beams and bogies more than the permanent way engineer, seeing that they permit of his exercising, with impunity, a minimum of care in the maintenance of the line. The badly maintained engine, with "plenty of play," as the chairman of the Midland Railway described it, just suits him. With him, therefore, the American engine, with its loose joints, is a great favorite; but whether this preference is conducive to railway economy and a minimum of working expenses is another matter. If, however, the roadway is of a substantial character, well laid and properly maintained, as is usual on well established, high-class railways, and steady running at high speeds is desired, then give me an engine without balance beams and with as little side play to the bogie as possible.

As regards the boilers, the dimensions of the grate and heating surface of British engines are based on the result of long experience as to proportions best adapted, in relation to the size of cylinders, quality of the fuel, and conditions of working in respect of speed, gradients, etc., to secure economy of fuel in combination with efficient performance of the duty for which the engines are intended—the duty having been well considered and determined beforehand, and clearly specified when placing the order for the engines. On the other hand, in consequence of its having fallen to the lot of American locomotive makers to design and manufacture engines, for the most part for inferior-class railways in new and undeveloped countries of vast extent with a highly fluctuating traffic, necessitating now and again the transport over long distances of exceptionally heavy trains, meeting with occasional lengths of steep gradients or other unfavorable conditions, and taxing to the utmost—even if it were only once or twice and for short lengths on a journey of 500 to 1,000 miles—the tractive powers of the engine, while, on the other hand, economy in working and the saving of fuel was a secondary consideration, American locomotive practice has from its earliest days gone in the direction of providing relatively large boilers with big grates and proportionate—though not always proportionate—heating surface. I should be the last to question the propriety of such a course from the locomotive maker's point of view, if the user of the engines is content to pay the extra price of the larger boiler in the first cost and upkeep, and is indifferent to the size of the coal bill. But there is a limit to the size of the boiler, even in American practice—which, in more senses than one, "is nothing if not extravagant," to paraphrase a familiar expression—it being recognized, even by American locomotive men, that the offhand expression, "a locomotive boiler can never be too big," in order to insure "plenty of steam," can be readily overdone.

What the desirable size of a boiler is all depends on the point of view from which we regard it. If I were an engine-driver, working a heavy train on a bad night, with wind and weather and fuel against me, and likely to have a few extra coaches or loaded wagons thrust upon my already fully loaded engine by an uncontrolled traffic department, I should be a strenuous advocate of the "cannot-be-too-big-a-boiler" theory. But if I were a locomotive superintendent, liable to be hauled over the coals by my board of directors for the higher cost of the engines to start with, and secondly, for the extravagance of my working expenses in fuel and repairs, I should in that case specify dimensions for the boilers more in accord with the agreed duty for which the engines are wanted, and I should, as a duty to my engine-drivers, see to it that the traffic department adhered strictly to the train-load rules. On well regulated railways, both at home and abroad, some personal effort is still expected from drivers and firemen in the way of working trains through at a pinch, so as to avoid the adoption of unnecessarily big engines to meet an occasional emergency, the big engines having in all probability to run for days or weeks together with loads much within their capacity; the average weight of their trains in course of the year amounting in practice to not more than two-thirds, or three-quarters at the outside, the full capacity of the engines. In not so well-established railways in out-of-the-way districts, and with spasmodic traffic, to which I have alluded, boilers in excess of the proportions best suited for well-established lines may be advantageous. But, whatever size of boiler may be considered best by the railway authorities who have the duty of ordering the engines, there is no law, either physical or human, so far as I am aware, which stands in the way of that same size of boiler being used by British locomotive makers equally with American engine makers. For this reason I never could understand why pro-American locomotive advocates make such a point of a "big boiler," as if it were something inherent in American soil which could not be produced in British territory.

I have, however, already exceeded, I fear, the permissible limits of a communication of this kind, and must therefore reserve any comments on the details of American and English engines, as well as on the "engine-off-the-peg" aspect of the question, in its bearing on the competition between the two countries, until another time.

But, before concluding, I would offer one remark on the notion, apparently current among those of limited experience in the working of locomotive engines, namely, that the use of locomotive boilers of relatively large size is necessarily conducive to fuel economy as compared with the smaller boilers usual in British engines. Economy of fuel does not necessarily follow, and it may prove quite the reverse. Too small a boiler is, one need hardly say, necessarily wasteful of fuel, because it has to be over-forced. But if a boiler is suitably proportioned as regards grate area and heating surface for the normal work it is called upon to do, a larger boiler will prove wasteful rather than economical in fuel. It is not so, I know, in the case of stationary or other boilers doing regular work under a steady draught. The locomotive boiler, however, works under entirely different conditions, with a constantly varying draught, depending on the undulations of the road and other cognate causes. A fire of a certain depth has therefore to be maintained, whatever the actual duty of the engine may be at any moment, to stand the more or less frequently recurring violent draught which up-hill working causes, so as to guard against the liability of the fire being "pulled to pieces" and air-holes made, which draw in an excess of cold air, thereby causing a fall in the firebox temperature, a leaky condition of the tubes, and lessened steam production. On this account, the quantity of fuel used in a locomotive cannot be at all times regulated with a nicety to the work done. Consequently a big boiler, with its larger grate area, in requiring proportionately more coal to cover it properly to the required depth, may wastefully burn more fuel than the smaller boiler in doing the same work, as measured by the train-loads hauled, besides costing more to begin with; and if worked at the same pressure as the smaller one, it costs more in repairs and involves the transport of so much extra deadweight up and down the railway during the whole term of its natural life.—The Engineer.

AMERICAN LOCOMOTIVES IN EUROPE.

UP to the present, in spite of the large and continued importation of American machinery, the American locomotive, which has for many years been largely and successfully used in Russia, can hardly be said to have made more than an appearance in Germany.

The Bavarian state railway authorities have, during the past two years, ordered and used a small number of American locomotives for experimental purposes, and the Prussian government is also operating a couple of our engines. Up to the present no official report has been made as to the results of these experiments, and although the Bavarian authorities promised the Society of German Engineers at Berlin full information, it may still be a long time before any definite official report will be made. It has been ascertained, however, through reliable private sources, that the results obtained in Bavaria have been highly satisfactory, and have dissipated the belief which has hitherto prevailed in official circles, that American engines were not adapted for use on German railroads. It is therefore considered extremely probable that the American type of engine will be built by the German locomotive builders within a short time. The Prussian railroad authorities are at present experimenting with the so-called superheated steam engines made by Schmidt, in Cassel. Should these tests not prove satisfactory, it is thought likely that the American type of locomotive will be adopted in Prussia. Both cars and trains are uniformly much smaller and lighter in this country than in the United States, with the result that the percentage of dead weight hauled is greater and freight rates—especially for long distances—very much higher. The 10-ton freight car is still all but universal in Germany. Serious complaints are made by shippers of heavy freights, such as the iron and steel manufacturers of Westphalia, over high freight rates on their raw materials and products, and considerable pressure has been exercised to secure reductions. Since 1893, the year of the Chicago exposition, no important fact of American railway development has escaped the attention of German railway managers. Expert commissioners and individual engineers have gone to the United States, and spent months in studying every detail of construction and management. The vestibule express train and the sleeping and dining car have been copied almost literally. More recently the enormous freight trains of 40-ton cars, drawn by powerful locomotives worked up to their full capacity, have taught the German engineers the secret of cheap and effective freight traffic, and there is a demand for a new policy of larger and heavier rolling stock, in which both cars and engines shall be enlarged to the limit of safety with the present weight of rails and efficiency of tracks, bridges, switches, etc. This increase in weight will unquestionably bring a nearer conformity with the American type of freight engines. The somewhat unfavorable report of the Midland Railway, of England, as to the results of its practical use of American locomotives, has been explained by an American engineer to have been largely due to the fact that the heavy, powerful American engines were used to perform the same kind and quantity of work as the smaller English ones. According to the superintendent of the railroad, "the American locomotives which have been employed since the middle of 1899 are £500 ($2,433.25) cheaper in first cost, and are satisfactory as to power, but consume from 20 to 25 per cent more coal than those of English make. As good engines can be built in America as in England, but owing to the different methods of railroading in the two countries, the British locomotives are better adapted for use in England."

The German state railways buy their fuel from the coal and coke syndicates, and pay what would be considered in America exorbitant prices. Economy in fuel consumption is, therefore, and must remain, a point of prime importance, and no type of locomotive will be adopted by the Bavarian or Prussian railway administrations which does not conform closely to the German standard of efficiency in this respect. The American engines which have been thus far ordered and used in this country have been bought for purposes of study and experiment, and however efficient they may prove to be, it is, for obvious reasons, not to be expected that the German state governments will place any large contract for locomotives or other railway material with other than German manufacturers.

Aside from the railways owned and managed by the several state governments, there are a number of small lines, generally of a secondary nature, which are owned and operated by private companies independent of any political obligation and ready to buy their rolling stock where it can be obtained to the best advantage. Of the 18,291 locomotives in service in Germany in 1899, 17,491 belonged to the state railroads and 800 to private railway corporations.

The average weight of engines on German state railways is 42.67 tons, while those in use on private roads average 37.68 tons. During the year 1899, 446 engines

were purchased by the state railways and 56 by private companies. In the year 1898, $556,000 was spent for the purchase of new and the repair of old engines on private lines. These figures show the limited nature of the opportunity in Germany which is open to American competition. There are in Germany five or six leading locomotive builders who have grown up, so to speak, with the railway development of this country. The present equipment of both state and private lines is substantially their work. They are careful, conscientious builders, but slow, and one of the chief advantages which an American competitor would have is in the rapidity with which delivery could be made under urgent circumstances. In Germany, it is necessary to wait from four to eight months, and often for much longer periods, from the date of an order before the locomotive can be delivered, and, in case of injury to a part, it generally requires some weeks before it can be replaced. It is also customary in this country to order locomotives from drawing or catalogues, so that the purchaser has not the advantage of actual inspection of the machine which he needs for a certain service. The American system of building locomotives of certain uniform types, with interchangeable parts, is recognized as an advantage, and this, added to their lower cost and earlier delivery, constitute their chief merits for the European trade.

It goes without saying, however, that the principal opportunity for American railway engines is in countries which, unlike Germany, France and England, have no adequate facilities for building them at home. Such opportunities exist most notably in Russia, Turkey and the Balkan States, where considerable railway construction is now in progress and still more projected. No locomotives are manufactured in Turkey or the Balkan States, where German capital is being invested and where important development is to be expected within the next ten or twenty years.

In order to sell American locomotives in Europe, it would seem desirable that our leading American locomotive builders should establish an agency at some central location, such as Berlin or Paris, where close track could be kept of the needs of the European market and whence representatives with good technical education could be sent to confer with representatives of foreign railroads. The importance of having representatives of sufficient technical knowledge to answer all possible questions, and versed in foreign languages, was strongly insisted upon by a very successful seller of American machinery, with whom the matter was discussed. Recent sales to France and Russia and the satisfactory results of the experiments in Bavaria tend to show that there exists an opportunity for the sale of American locomotives in Europe. In order to make the most of this opportunity, all possible facilities should be given to the foreign buyer to judge of the nature of the American locomotive without the necessity of sending or going to the United States.—Dean B. Mason, Vice and Deputy Consul-General at Berlin.

THE USE OF HYDROCYANIC ACID GAS FOR EXTERMINATING HOUSEHOLD INSECTS.

WITH the growth of our population and the consequent crowding together of residences, the problem of the prevention and control of household insects is deserving of careful consideration from a sanitary standpoint, but one that is usually overlooked. These pests are to be found in fewer or greater number of both species and individuals in every dwelling, office or storehouse, and no perfectly efficient means, either to prevent their gaining an entrance, or to exterminate them when they are once established, has as yet been devised.

Recent successful applications of hydrocyanic acid gas for the extermination of insects infecting greenhouse plants have suggested the use of the same remedy for household pests. It is now no longer a theory, but an established fact, that .10 gramme of 98 per cent pure cyanide of potassium volatilized in a cubic foot of space, will, if allowed to remain for a period of not less than three hours, kill all roaches and similar insects.

The experiments which led to this conclusion were made in a small building which is used for laboratory purposes by the Division of Botany. This structure has for some time been infested with several insect pests, the more numerous and troublesome being the common cockroach (*Periplaneta Americana*). The building consists of one story and basement, the upper part being rather loosely built, as it is ceiled throughout with matched lumber. This method of construction provides numerous hiding-places for the insects and also renders fumigation difficult, by permitting the gas to escape too quickly. Within the building are several sources of moisture, a rather high and constant temperature is maintained in some of the rooms, and large quantities of seeds and substances that serve as food for insects are stored, making conditions well adapted to the development of cockroaches.

During the early part of last year the roaches became so numerous as to be a detriment to the work of the laboratory, and it was necessary to adopt some means of checking them. On the evening of May 10, 1900, the building was closed, and after opening up the interior of the rooms as much as possible the entire structure was fumigated experimentally with about .08 gramme of 98 per cent pure cyanide of potassium per cubic foot of space. The gas was allowed to remain during the night, or until it gradually escaped. When the rooms were entered the following morning, there remained a perceptible odor of the gas, but this soon disappeared after opening the windows and doors. The ledges and window sills were strewn with dead house flies, and the floors bore abundant evidence of the effect of the gas on roaches. Not a single insect that showed indications of remaining life was to be found in the building. About a quart of the flies and roaches was gathered up and placed in a cage where they were allowed to remain until the following day, when two roaches showed signs of life by slow movements; these, however, could not walk when placed upon their feet, and subsequently died.

For some time after this fumigation no roaches were to be found in the building, but eventually the eggs that had been previously deposited hatched and developed, adults were carried in from other buildings, etc., until in March of the present year the roaches had again become so numerous as to be a nuisance and a detriment to the work of the laboratory. The building was again treated with cyanide gas, this time at the rate of .10 gramme per cubic foot of space, but was allowed to remain only 50 minutes, when the windows were opened and the gas permitted to escape. The roaches were strewn over the floors, and several mice were found dead. A large number of the roaches were again collected and kept in a cage until the following day, when it was found that fully 10 per cent of them had not been killed and were as lively as before treatment; the mice, however, showed no indications of life. The dose had been sufficiently strong, but had not been allowed to remain long enough to kill the more resistant of the roaches.

The third and most satisfactory experiment of the series was conducted on the evening of June 20, 1901, when an application of .10 gramme per cubic foot was allowed to remain in the building over night. On the following morning the gas had not entirely escaped, and house flies, centipedes, spiders, cockroaches, and mice were dead, with the exception of a few roaches that had secreted themselves between the sash and frame of a loosely-fitting window and had thus secured enough pure air to prevent their being killed.

To convey an idea of the injury caused by the presence of large numbers of roaches in this laboratory, it might be stated that frequently preceding this last fumigation, photographic plates placed on racks to dry and allowed to remain on a table for one hour were completely ruined by having the films eaten from the glass; packets of seeds stored in mouse-proof tin boxes were so eaten as to allow the seeds to escape, and in many cases the seeds themselves were destroyed. Since this fumigation no inconvenience has been caused by the work of roaches or mice.

By the aid of the results obtained from the above experiments, together with our present knowledge of the action of hydrocyanic acid gas in exterminating greenhouse and scale insects, it may be stated that a dwelling, office, warehouse or any building may be economically cleared of all pests, provided that the local conditions will permit the use of this gas. It probably would be dangerous to fumigate a building where groceries, dried fruits, meats or prepared food materials of any kind are stored. Air containing more than 25 per cent of the gas is inflammable; therefore it would be well to put out all fire in an inclosure before fumigating. Hydrocyanic acid, in all its forms, is one of the most violent poisons known, and no neglect should attend its use. There is probably no sure remedy for its effects after it has once entered the blood of any of the higher animals. When cyanide of potassium is being used it should never be allowed to come in contact with the skin, and even a slight odor of the gas should be avoided. Should the operator have any cut or break in the skin of the hands or face it should be carefully covered with court plaster to prevent the gas coming in contact with the flesh, or the possibility of a small particle of the solid compound getting into the cut, which would cause death by poisoning in a few minutes' time.

Hydrocyanic acid gas should not be used in closely-built apartments with single walls between, as more or less of the gas will penetrate a brick wall. An inexperienced person should never use cyanide of potassium for any purpose, and if it be found practicable to treat buildings in general for the extermination of insects, the work should be done only under the direction of competent officials. Our experiments have shown that a smaller dose and a shorter period of exposure are required to kill mice than for roaches and household insects generally, and it readily follows that the larger animals and human beings would be more quickly overcome than mice, since a smaller supply of pure air would be required to sustain life in mice, and small openings are more numerous than large ones.

The materials employed and the method of procedure are as follows: After ascertaining the cubic content of the inclosure, provide a glass or stoneware (not metal) vessel of 2 to 4 gallons capacity for each 5,000 cubic feet of space to be fumigated. Distribute the jars according to the space, and run a smooth cord from each jar to a common point near an outside door where they may all be fastened; support the cord above the jar by means of the back of a chair or other convenient object in such a position that when the load of cyanide of potassium is attached it will hang directly over the center of the jar. Next weigh out upon a piece of soft paper 500 grammes (about 17.1 ounces) of 98 per cent pure cyanide of potassium, using a large pair of forceps for handling the lumps; wrap up and place in a paper bag and tie to the end of the cord over the jar. After the load for each jar has been similarly provided, it is well to test the working of the cords to see that they do not catch or bind. Then remove the jar a short distance from under the load of cyanide and place in it a little more than a quart of water, to which slowly add one and one-half pints of commercial sulphuric acid, stirring freely. The action of the acid will bring the temperature of the combination almost to the boiling-point. Replace the jars beneath the bags of cyanide, spreading a large sheet of heavy paper on the floor to catch any acid that may possibly fly over the edge of the jar when the cyanide is dropped, or as a result of the violent chemical action which follows. Close all outside openings and open up the interior of the apartment as much as possible, in order that the full strength of the gas may reach the hiding-places of the insects. See that all entrances are locked or guarded on the outside to prevent persons entering; then leave the building, releasing the cords as you go. The gas will all be given off in a few minutes, and should remain in the building at least three hours.

When the sulphuric acid comes in contact with the cyanide of potassium the result is the formation of sulphate of potash, which remains in the jar, and the hydrocyanic acid is liberated and escapes into the air. The chemical action is so violent as to cause a sputtering, and frequently particles of the acid are thrown over the sides of the jar; this may be prevented by supporting a sheet of stiff paper over the jar by means of a hole in the center, through which the cord supporting the cyanide of potassium is passed, so that when the cord is released the paper will descend with the cyanide and remain at rest on the top of the jar, but will not prevent the easy descent of the cyanide into the acid. The weight of this paper will in no way interfere with the escape of the gas.

At the end of the time required for fumigation the windows and doors should be opened from the outside and the gas allowed to escape before anyone enters the building. A general cleaning should follow, as the insects leave their hiding-places and, dying on the floors, are easily swept up and burned. The sulphate of potash remaining in the jars is poisonous and should be immediately buried and the jars themselves filled with earth or ashes. No food that has remained during fumigation should be used and thorough ventilation should be maintained for several hours. After one of our experiments it was noted that ice water which had remained in a closed cooler had taken up the gas, and had both the odor and taste of cyanide.

For dwellings one fumigation each year would be sufficient, but for storage houses it may be necessary to make an application every three or four months to keep them entirely free from insect pests. The cost of materials for one application is about 50 cents for each 5,000 cubic feet of space to be treated. The cyanide of potassium can be purchased at about 35 cents per pound, and the commercial sulphuric acid at about 4 cents per pound. The strength of the dose may be increased and the time of exposure somewhat shortened, but this increases the cost and does not do the work so thoroughly. In no case, however, should the dose exceed .22 gramme or remain less than one hour.

The application of this method of controlling household insects and pests generally is to be found in checking the advance of great numbers of some particular insect, or in eradicating them where they have become thoroughly established. This method will be found very advantageous in clearing old buildings and ships of cockroaches.—W. R. Beattie, of the Division of Botany, U. S. Department of Agriculture, in Science.

EXPORTS OF BOOTS AND SHOES.

THE remarkable increase in our exports of boots and shoes during the past few years has frequently been referred to, and it is worth noting in this connection that the English exports show a tendency to decrease rather than increase. England has for many years been a large exporter of shoes, and in 1862, when the amounts were first reported separately, the exports were 5,375,748 pairs, valued at $7,999,137. The United States in the same year exported shoes to the value of $721,241. For twenty years following the English exports varied but little, the figures for some years dropping to $6,000,000 worth and others reaching $8,000,000. The United States exports increased to a little over $2,000,000 worth in the year 1865, but dropped back again the following year to less than $600,000. There were further declines until 1894, when our shoe exports amounted to less than $400,000. In the years following there were gains, and in 1892 the total exceeded $900,000. It was not until 1895, however, that the exports began to show positive gains, and in that year the total slightly exceeded $1,000,000.

The English exports in the meantime did not vary much from the $7,000,000 line, and some years approached closely to $8,000,000. In 1892 the figures were about $7,200,000, and since then the tendency has been to decrease. The following is a comparison for the past three years, the English figures being for calendar years and those of the United States for fiscal years ending June 30:

	English Shoe Exports.	United States Shoe Exports.
1898.....	$6,339,306	$1,816,538
1899.....	6,063,084	2,711,385
1900.....	6,313,918	4,276,656

The fiscal year ended June 30, 1901, shows exports which are getting pretty close to the English figures. British exports for the six months ending June 30 were very little in excess of those from the United States for the same period, and it is reasonably certain that the increase will continue, so that the calendar year 1901 will show the United States with a clear lead in the boot and shoe exports. England, moreover, is increasing the imports of boots and shoes, the figures for the three years being $2,171,210 for 1898, $2,764,884 for 1899, and $2,942,457 for 1900. It is somewhat curious to note that our increased exports for the three years given have had no appreciable effect in reducing the English exports. This would indicate that new markets or new customers are being found for our increased shipments. Even in Australia, where we come into direct competition with the English manufacturers, and where we have increased our shipments from $62,000 in 1895 to $225,679 in 1898, and to $1,174,497 in 1900, the English manage to show some gains also, increasing from $1,530,020 in 1898 to $1,620,275 in 1900.—Boot and Shoe Recorder.

ABOUT SHOE POLISHES.

THE following suggestions as to the safest course in buying shoe polishes and the best method of advertising their presence in the store, from a writer in The Shoe and Leather Gazette, may be of service to some of our readers:

"There are a great many different kinds of polishes on the market to-day, each one claimed by the manufacturer to be the 'best.' Some of them are very good and some are extremely bad. If a dealer has experimented until the right polish is discovered, he should stick to it. It is true that there are a lot of new things brought out that will bear investigation and may prove worthy of a place in the findings department. But the thing to avoid is buying any large quantity of a thing until sure how good it is. A small trial order will demonstrate the worth of any article if the manufacturer is reliable. Trial orders are sometimes 'baited,' and the goods are selected with an eye to getting a big order on the strength of the 'bait.' No reputable dealer, however, will descend to such means. The buyer should choose his dealer as well as the goods. A well-known house, a house that has a reputation, is the safest always. Polishes are one of the most important of all in the findings

department. The right kind preserve the shoes and make friends. The wrong kind will prove a boomerang. Get the right kind and keep them.

"Most pastes and dressings require a cool place away from the light to preserve them properly. It is not a good idea to pile a window full of dressings in bottles. If a window display is desired, let the dealer use the empty paper boxes with a few bottles through the show to give life. Pastes are nearly always put up in tin boxes, which preserve them well if kept out of the sunshine. A shoedealer had a pyramid of dressings in bottles in his window not long ago, and had built a foundation of the tin paste boxes. He neglected the window and allowed it to stand too long. The result was he had a lot of damaged goods on his hands. The sun shone on his window nearly all day, and, as he had no awning, the goods dried up. Showcases should be secured for shoe dressings, and a nice display kept in view, but the best place for stock in bulk is in a drawer or shelf where heat and light will not penetrate."

THE OBSERVATORY AT NICE.

As well known, M. Bischoffsheim, of the Institute, in 1899 presented his magnificent observatory at Nice to the University of Paris, which accepted it. In addition, he gave the sum of 2,500,000 francs, the interest on which, after his death, will be used for maintaining the different services of the establishment. A managing committee has been appointed for life. Not long ago the Paris-Nice evening express carried the majority of the committee to Nice in order to take possession of the gift. The train set the delegation down at Antibes, where it was received by M. Bischoffsheim. Carriages then took the party to Biot, and thence to Nice, whence the delegation proceeded to visit the observatory, situated at 3.7 miles from the city.

Back of Nice there was formerly a small arid mountain over which herds of cattle passed. M. Bischoffsheim, after difficulties of all sorts, and at an outlay of millions of francs, transformed Mont Gros into a park of 90 acres, in the center of which stand the various structures of the observatory. After passing the gate a wide avenue 2,755 feet in length has to be traversed before the princely residence of M. Perrotin, the director, is reached. Farther along rises the immense cupola of the great equatorial. After observing Venus, Castor, Regulus, etc., in the telescope the delegation visited all the structures of the observatory and made a careful examination of the instruments contained therein.

Among the peculiarities that characterize the Nice observatory and distinguish it from all others, there are a few to which attention has not yet been directed and that are worthy of mention. One of the most curious and important for the control of the meridian observations is the installation of a sight situated at a distance of 3.7 miles upon the side of Mont Macaron on the opposite side of the valley of the Paillon.

This apparatus consists of an astronomical telescope in the focus of which, at right angles with the axis, is placed a small plane mirror. When a pencil of light is sent into the axis of this telescope the pencil falls upon the plane of the mirror and is reflected in such a way that upon its exit from the telescope it resumes the same path, but in an opposite direction. The optical peculiarity that makes this arrangement a success is this: The luminous returning pencil (Fig. 4) extends through diffraction, so that, after traversing anew the 3.7 miles that separate the apparatus from the focus of emission, the pencil covers quite a space around the luminous source. The result is that if, with a lateral telescope, we examine the sight thus illuminated we shall perceive, as it were, a small star which is so much the more brilliant in proportion as the line of vision is nearer the line of emission. The Macaron sight utilizes this phenomenon for furnishing the great meridian telescope with a true artificial star that is lighted at night without the necessity of going to this great distance to carry a beacon. It suffices to turn a commutator which lights two electric lamps placed in the focus of two illuminators directed toward the sight. These two illuminators are established upon the same pillar and are placed outside of the meridian pavilion symmetrically on each side of the observation telescope.

The object of this sight is to furnish a fixed direction in azimuth. It is much superior to the ordinary sights employed in observatories. The Macaron sight is established upon the rock at so great a distance that it would require very unusual motions of the ground to produce an appreciable deviation.

M. Cornu, to whom is due the idea of the installation of this apparatus, which has been in operation for more than ten years, was able to show the visitors the illumination of it by day through the use of a pencil of solar light. To M. Cornu also is due the installation of a system of synchronization of four astronomical clocks that are used for the three equatorials and the small meridian. A very short electric current is sent every two seconds into the circuit of the four clocks, and serves to give their pendulums exactly the same period as that of the current, despite the slight irregularities that these apparatus may present. Such a result is obtained through the electro-magnetic attraction exerted by the synchronizing current in traversing a coil of wire upon a magnet (Fig. 3) fixed to the pendulum. To this effect one of the poles of the magnet, fixed beneath the lens, penetrates the coil and, every two seconds, that is to say, at every double oscillation of the pendulum, receives an attraction sufficiently energetic to set the pendulum in motion, starting from a state of rest. The amplitude of the swing of the pendulum would therefore tend to increase indefinitely were it not prevented by an electromagnetic device that causes the amplitude rapidly to converge toward a limit that it cannot exceed. This device consists of a thick tube of copper placed in a position symmetrical with the synchronizing coil. The other pole of the magnet enters the axis of this tube and develops therein induced currents proportional to the velocity of displacement. Since the production of currents involves a development of heat, that is to say, an expenditure of energy, it will be seen by what electromagnetic mechanism the excess of the work of attraction produced by the synchronizing current is consumed at every oscillation, and why the amplitude reaches an insurmountable limit easy to regulate.

The regularity of the running of the synchronized clocks naturally depends upon the regularity of the emission of the synchronizing current, or, in other words, upon the directing clock. This latter is quite original. It is a simple pendulum 13 feet length, entirely of iron, weighing 237.6 pounds, and with an amplitude of oscillation exceeding scarcely one degree. This pendulum (installed in the basement of the great equatorial, where the temperature varies with extreme slowness) offers, through its mass and feeble amplitude, extraordinary regularity. It consumes an extremely feeble motive power. The work furnished by the auxiliary wheelwork is produced by the motive weight of 4.4 pounds descending 52.5 feet a day.

Finally, it is well to explain how the control of the four clocks is effected. The wheelwork of the directing clock emits every two minutes an almost instantaneous current which passes through an auxiliary circuit that traverses four telephones placed alongside of each clock.

The astronomer whose business it is to take the time listens to the sound in the telephone and notes the minute, the second and the tenth of a second to which it corresponds. As all the clocks are regulated once for all, and the sound occurs at the same minute and the same second in each telephone, the simple hearing of the sound at the time expected suffices to show whether or not everything is in a proper state. This telephonic addition has so simplified the work of the astronomer in charge of the time service that the control no longer requires anything but a few minutes' walk in the four halls in which the synchronized clocks are kept. Formerly he was obliged to make the comparison with a chronometer, the carriage of which led to complications, and also had to make a calculation of reduction which involved a laborious operation of more than an hour's time.

Owing to the patronage of the Bureau of Longitudes, which up to recent times has in a manner been the scientific inspirer of the Nice observatory, many improvements have been suggested or progressively introduced. Among the original projects should be mentioned the organization of a regular service of meteorological optics for the observation of all the phenomena directly related to terrestrial physics, such as halos, parhelions, coronas, polar auroras, etc. The attention of the observers is directed particularly to the absorption and diffusion of light by the atmosphere, the determination of the aqueous vapor deduced from an observation of the telluric rays and the polarization of the blue light of the sky, which

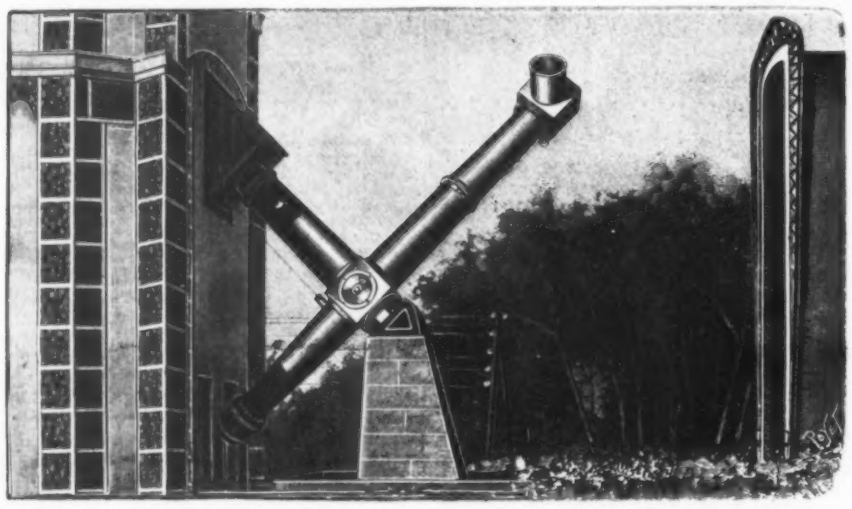


FIG. 1.—THE ELBOWED EQUATORIAL AND ITS IRON-PLATE HOUSING.

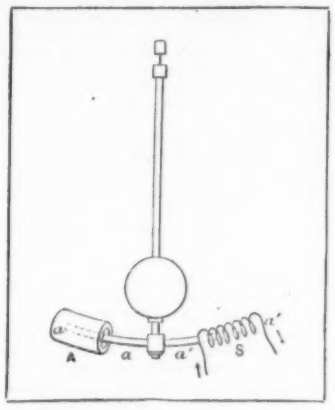


FIG. 3.—ELECTRO-MAGNETIC SYNCHRONIZATION OF THE PENDULUM OF A CLOCK.

a a', magnet fixed to the pendulum; *S*, solenoid that produces the periodical attraction of the pole, *a'*, under the influence of the synchronizing current; *A*, tube of thick copper (seat of the currents induced by the oscillation of the pole, *a*) forming a deadener.

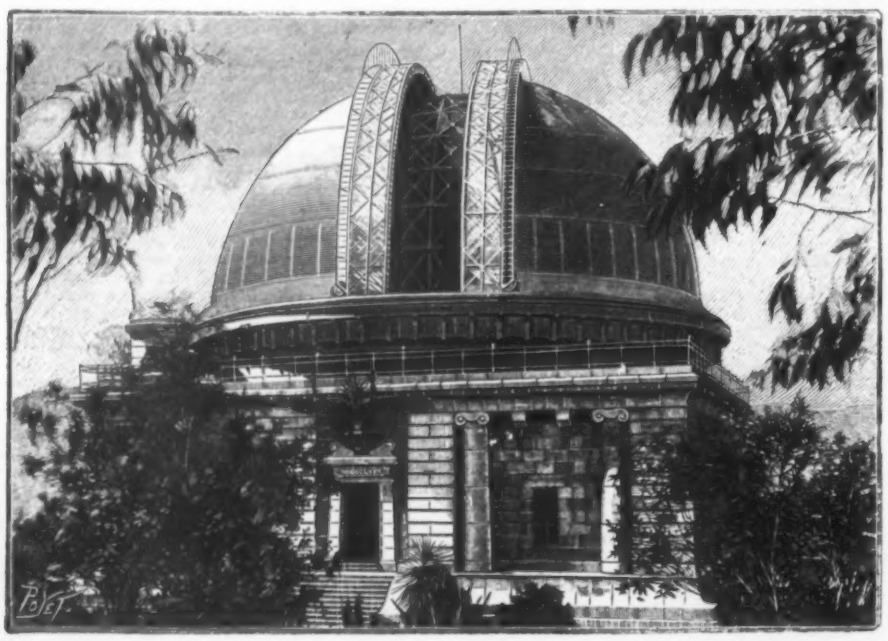


FIG. 2.—EXTERNAL VIEW OF THE PAVILION OF THE GREAT EQUATORIAL.

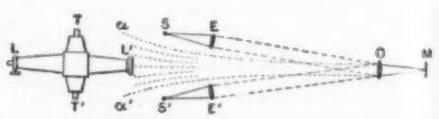


FIG. 4.—MONT MACARON SIGHT SERVING AS A REFERENCE POINT (ARTIFICIAL STAR) FOR THE TELESCOPE OF THE GREAT MERIDIAN CIRCLE OF THE NICE OBSERVATORY.

O, objective of the telescope forming the distant sight; *M*, focal mirror; *S E S' E'*, illuminators of the sight; *S S'*, electric lamps; *E E'*, objectives; *a α a'*, pencil of light expanded by diffraction and emanating from the objective of the sight; *L L'*, telescope of the great meridian circle movable upon trunnions, *T T'*.

appears to play a prominent meteorological rôle. The studies were begun several years ago by means of the Cornu photopolarimeter.

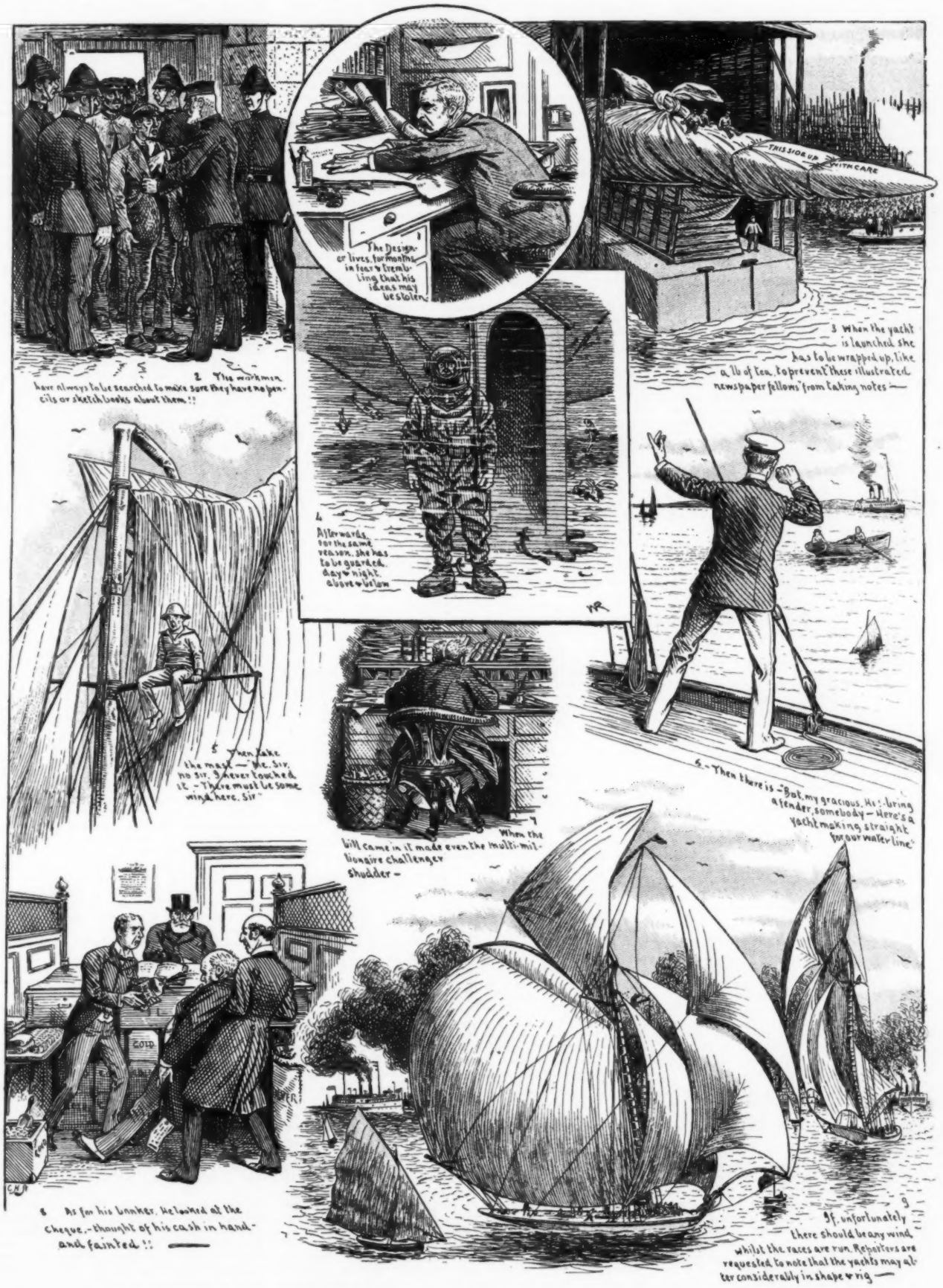
The measurement of the proportion of polarized light upon a cloudless sky, at the point situated in the vertical plane of the sun at 90 deg. from the latter, is an easy operation. A sudden variation in such proportion permits of announcing a change in the nature of the winds before the barometer indicates it. In the fine climate of Nice, where the sky is so often pure, a regular study of the polarization thereof will not fail to give very interesting results.—For the photographers, is certainly one of the most humorous of the sketches.

THE FUNCTIONS OF A UNIVERSITY.*

THE word university has borne many significations; and, indeed, its functions are various, and the signification attached to the word has depended on the particular point of view taken at the time. An eminent German, who visited me some years ago, made the remark after seeing University College: "Aber, lieber Herr College, University College ist eine kleine Universität." So it is; for it fulfills most of the functions of the most successful universities in the world. And why is this? Because the traditions of University College have always been, that it is not merely a place where known facts and theories should be administered in daily doses to young men and young women, but that the duties of the professors, assistant professors, teachers, and advanced students is to increase knowledge. That is the chief function of a university—to increase knowledge. But it is not the only one.

A university has always been regarded as a training school for the "learned professions," i. e., for theology, law, and medicine. The terms of our charter have excluded the first of these branches of knowledge. Founded as it was in the '20's, when admission to Oxford or Cambridge involved either belief in the tenets of the Church of England or insincerity, it was not possible to provide courses in theology which should be acceptable to Nonconformists, Jews and others who desired education. On the whole, it appears to me better that a subject about which so much difference of opinion exists should be taught in a separate institution. There are many branches of knowledge which can be adequately discussed without intruding into any sphere of religious controversy; and, indeed, it would be difficult, I imagine, to treat mathematics or chemistry from a sectarian standpoint. I at least have never tried. There are subjects which may be placed on the border-line, for example, philosophy; but such subjects, and they are few in number, might well form part of the curriculum of the theological college, if thought desirable. It is a thousand pities that instead of founding King's College a theological college had not been established in the immediate neighborhood of University College; it

* Oration delivered at University College, London, on June 6, by Prof. W. Ramsay, F.R.S.


1 The Designer lives for months in fear & trembling that his ideas may be stolen
2 The workmen have always to be searched to make sure they have no pencils or sketch books about them!!
3 When the yacht is launched she has to be wrapped up, like a lb of tea, to prevent these illustrated newspaper fellows from taking notes
4 Afterwards for the same reason, she has to be guarded, day & night, above & below
5 Then take the mast — Mr. Sir, no sir, I never touched it. — There must be something here, Sir
6 As for his banker, he looked at the cheque, thought of his cash in hand and fainted!!
7 When the bill came in it made even the multi-millionaire challenger shudder —
8 Then there is — But, my gracious, Hi! bring a fender, somebody — Here's a yacht making straight for our waterline
9 If, unfortunately there should be any wind, whilst the races are run, Reporters are requested to note that the yachts may alter considerably in shape & rig

THE STORY OF A CUP CHALLENGER—A WARNING TO MILLIONAIRE YACHT OWNERS.

above particulars and the engravings we are indebted to La Nature.

THE COMIC SIDE OF YACHTING.

So much has been said recently about the serious side of yachting that the humorous phases of the subject are not generally apparent. The London Graphic recently devoted a page to what is entitled "The Story of a Cup Challenger." Some of our readers may be pleased to see these pictures, so we have reproduced them for this issue. The idea of the diver in front of a sentry-box, on the lookout for submarine amateur

would have strengthened us, and it would have tended, too, to the advantage of the Church of England. However, what is done can't be undone; and let us wish all prosperity to our sister college, and a long and a useful life. We are now friends, and have been friends for many years. May that friendship long continue!

Dismissing the faculty of theology, therefore, as out of our power, as well as beyond our wishes, let us turn to the remaining two learned professions. University College, I believe, was the first place in England where a systematic legal education could be obtained. Our chairs of Roman law, constitutional law and jurisprudence were the first to be established in England, although such chairs had for long been known on the Continent, and in Scotland. "Imitation is the sincerest flattery," and in the fullness of time the Inns of Court started a school of their own. Our classes, which used to be crowded, dwindled, and our law school is certainly not our strongest feature. I am not sufficiently acquainted with English legal education to pronounce an opinion as to whether methods of training as they at present exist in England are the most effective; I have heard rumors that they are not. That must be left to specialists to decide. But arguing from the experience of another faculty, in which the apprenticeship system once existed, and which has changed that system with a view to reform, and judging, too, from the experience abroad and in Scotland, I venture to think that some improvement in legal education is possible. If that opinion is correct it is surely not too much to hope that the claims of University College may be considered as having made the first attempt to systematize legal education in England.

The faculty of medicine has existed in a flourishing state since the inception of University College. Not long after the college was built, the hospital buildings, of which we have the last unsightly remains still before our eyes, were erected. One of my predecessors on a similar occasion to this has given you an entrancing account of the early history of this side of the college, and has discoursed on the eminent men who filled the chairs in the medical faculty. Here young men whose intention it is to enter the medical profession are trained; they now receive five years' instruction in the various branches of knowledge bearing on their important calling. I would point out that this function of a university is professedly a technical one—the training of medical men. True, many researches have been made by the eminent men who have held chairs in this faculty; but that is not the primary duty of such men; their duty is to train others to exercise a profession. If they advance their subject in doing so, so much the better; it increases the fame of the school, it imparts enthusiasm to their students, and in many cases their discoveries have been of unspeakable benefit to the human race. In a certain sense, every medical man is an investigator; the first essential is that he shall be able to make a correct diagnosis; the next, that he shall prescribe correct treatment. But novelty is not essential; few men evolve new surgical operations or introduce new remedies, and though we have in the past had not a few such, they are not essential for a successful medical school, the object of which is to train good practical working physicians and surgeons. The teaching staff of the medical faculty must of necessity be almost all engaged in practice, and, indeed, it would be unfortunate for their students if they were merely theoretical teachers. Let me again recapitulate my point; the medical faculty is essentially a technical faculty; the hospital is its workshop.

In England, of recent years, schools of engineering have been attached to the universities. Abroad and in America they are separate establishments, and are sometimes attached to large engineering shops, where the pupils pursue their theoretical and practical studies together, taking the former in the morning, the latter in the afternoon. Here again the subject is a professional one. The object of the student is to become a practical engineer, and all his work is necessarily directed to that end. Like other workers in different fields, his aim is the acquisition and utilization of "power," but in his case it is his object to direct mechanical and electrical power so as to add to the convenience of the public. A machine is an instrument for converting heat or electrical energy into what is termed "kinetic energy," and it is with the laws and modes of this conversion that he has to deal. Such abstract sciences as chemistry, physics, and geology, therefore, are studied as means to an end, not for their own sakes. They afford him a glimpse of the principles on which his engineering practice is based; and mathematics is essential in order that he may be able to apply physical principles to the practical problems of his profession.

We see, then, that a university, as it at present exists, provides, or may provide, technical instruction for theologians, for lawyers, for medical men and for engineers. It is, in fact, an advanced technical school for these subjects.

But it is more, and I believe that its chief function lies in the kind of work which I shall attempt now to describe. The German universities possess what they term a "philosophical faculty;" and this phrase is to be accepted in the derivational meaning of the word—a faculty which befriends wisdom or learning. The watchword of the members of this faculty is research; the searching out the secrets of nature, to use a current phrase, or the attempt to create new knowledge. The whole machinery of the philosophical faculty is devised to achieve this end; the selection of the teachers, the equipment of the laboratories and libraries, the awarding of the degrees.

What are the advantages of research? Much is heard nowadays regarding the necessity of state provision for its encouragement, and the government places at the disposal of the Royal Society a sum of no less than £4,000 a year, which is distributed in the form of grants to applicants who are deemed suitable by committees appointed to consider their claims to assistance.

There are two views regarding the advantage of research which have been held. The first of these may be termed the utilitarian view. You all know the tale of the man of science who was asked the use of research and who parried with the question: What is the use of a baby? Well, I imagine that one school of political economists would oppose the practice of child-murder on the ground that potentially valuable property was being destroyed. These persons would probably not be those who stood to the baby in a parental relation. Nor are the most successful investigators those who pursue their inquiries with the hope of profit, but for the love of them. It is, however, a good thing, I believe, that the *profanum vulgus* should hold the view that research is remunerative to the public—as some forms of it undoubtedly are.

The second view may be termed the philosophical one. It is one held by lovers of wisdom in all its various forms. It explains itself, for the human race is differentiated from the lower animals by the desire which it has to know "why." You may have noticed, as I have, that one of the first words uttered by that profound philosopher, a small child, is "why." Indeed, it becomes wearisome by its iteration. We are the superiors of the brutes in that we can hand down our knowledge. It may be that some animals also seek for knowledge; but at best it is of use to themselves alone; they cannot transmit it to their posterity, except, possibly by the way of hereditary faculties. We, on the contrary, can write and read; and this places us, if we like, in the possession of the accumulated wisdom of the ages.

Now the most important function, I hold, of a university is to attempt to answer that question, "why?" The ancients tried to do so; but they had not learned that its answer must be preceded by the answer to the question, "how?" and that in most cases—indeed, in all—we must learn to be contented with the answer to "how?" The better we can tell *how* things are, the more nearly shall we be able to say *why* they are.

Such a question is applicable to all kinds of subjects; to what our forerunners on this earth did; how they lived; if we go even further back, what preceded them on the earth. The history of these inquiries is the function of geology, palæontology and palæontological botany; it is continued through archæology, Egyptian and Assyrian, Greek and Roman; it evolves into history, and lights are thrown on it by languages and philology; it dovetails with literature and economics. In all these, research is possible; and a university should be equipped for the successful prosecution of inquiries in all such branches.

Another class of inquiries relates to what we think and how we reason; and here we have philosophy and logic. A different branch of the same inquiry leads us to mathematics, which deals with spatial and numerical concepts of the human mind, geometry, and algebra. By an easy transition we have the natural sciences; those less closely connected with ourselves as persons, but intimately related to our surroundings. Zoology and botany, anatomy, physiology, and pathology deal with living organisms as structural machines, and they are based on physics and chemistry, which are themselves dependent on mathematics.

Such inquiries are worth making for their own sakes. They interest a large part of the human race, and not to feel interested in them is to lack intelligence. The man who is content to live from day to day, glad if each day will but produce him food to eat and a roof to sleep under, is but little removed from an uncivilized being. For the test of civilization is *prevision;* care to look forward; to provide for to-morrow; the to-morrow of the race, as well as the to-morrow of the individual; and he who looks furthest ahead is best able to cope with nature, and to conquer her.

The investigation of the unknown is to gather experience from those who have lived before us, and to secure knowledge for ourselves and for those who will succeed us. I see, however, that I am insensibly taking a utilitarian view; I by no means wish to exclude it, but the chief purpose of research must be the acquisition of knowledge, and the second its utilization.

I will try to explain why this is so, and here you must forgive me if I cite well-known and oft-quoted instances.

If attempts were made to discover only useful knowledge (and by useful I accept the vulgar definition of profitable, i. e., knowledge which can be directly transmitted into its money equivalent) these attempts would, in many, if not in most, cases fail of their object. I do not say that once a principle has been proved and a practical application is to be made of it that the working out of the details is not necessary. But that is best done by the practical man, be he the parson, the doctor, the engineer, the technical electrician, or the chemist, and best of all on a fairly large scale. If, however, the practical end is always kept in view, the chances are that there will be no advance in principles. Indeed, what we investigators wish to be able to do, and what in many cases we can do, although perhaps very imperfectly, is to prophesy, to foretell what a given combination of circumstances will produce. The desire is founded on a belief in the uniformity of nature; on the conviction that what has been will again be, should the original conditions be reproduced. By studying the consequences of varying the conditions our knowledge is extended; indeed, it is sometimes possible to go so far as to predict what will happen under conditions, all of which have never before been seen to be present together.

When Faraday discovered the fact that when a magnet is made to approach a coil of wire an electric current is induced in that wire, he made a discovery which at the time was of only scientific interest. That discovery has resulted in electric light, electric traction, and the utilization of electricity as a motive power; the development of a means of transmitting energy, of which we have by no means seen the end; nay, we are even now only at its inception, so great must the advance in its utilization ultimately become.

When Hofmann set Perkin as a young student to investigate the products of oxidation of the base aniline, produced by him from coal tar, it would have been impossible to have predicted that one manufactory alone would possess nearly 400 large buildings and employ 5,000 workmen, living in its own town of 25,000 inhabitants, all of which is devoted to the manufacture of colors from aniline and other coal tar products. In this work alone at least 350 chemists are employed, most of whom have had a university training.

Schönbein, a Swiss schoolmaster interested in chemistry, was struck by the action of nitric acid on paper and cotton. He would have been astounded if he had been told that his experiments would have resulted in the employment of his nitro-celluloses in colossal quantity for blasting, and for ordnance of all kinds, from the 90-ton gun to the fowling-piece.

But discoveries such as these, which lead directly to practical results, are yet far inferior in importance to others in which a general principle is involved. Joule and Robert Mayer, who proved the equivalence of heat and work, have had far more influence on succeeding ages than even the discoverers above mentioned, for they have imbued a multitude of minds with a correct understanding of the nature of energy and the possibility of converting it economically into that form in which it is most directly useful for the purpose in view. They have laid the basis of reasoning for *machines;* and it is on machines, instruments for converting unavailable into available energy, that the prosperity of the human race depends.

You will see from these instances that it is in reality "philosophy" or a love of wisdom which, after all, is most to be sought after. Like virtue, it is its own reward; and as we all hope in the case with virtue, too, it brings other rewards in its train, not, be it remarked, always to the philosopher, but to the race. Virtue, pursued with the direct object of gain, is a poor thing; indeed, it can hardly be termed virtue if it is dimmed by a motive. So philosophy, if followed after for profit, loses its meaning.

But I have omitted to mention another motive which makes for research; it is a love of pleasure. I can conceive no pleasure greater than that of the poet—the maker—who wreathes beautiful thoughts with beautiful words; but next to this I would place the pleasure of discovery, in whatever sphere it be made. It is a pleasure, not merely to the discoverer, but to all who can follow the train of his reasoning. And after all, the pleasure of the human race, or of the thinking portion of it, counts for a good deal in this life of ours.

To return. Attempts at research, guided by purely utilitarian motives, generally fail in their object, or at least are not likely to be so productive as research without ulterior motive. I am strengthened in this conclusion by the verdict of an eminent German who has himself put the principle into practice; who after following out a purely theoretical line of experiment, which at first appeared remote from profit, has been rewarded by its remunerative utilization. He remarked, incidentally, that the professors in polytechnika—(what we should term technical colleges, intended to prepare young men for the profession of engineering and technical chemistry)—were less known for their influence on industry than university professors. The aim is different in the two cases; the polytechnika train men for a profession, the philosophical faculty of German universities aims at imparting a love of knowledge; and, as a matter of fact, the latter *pay* in their influence on the prosperity of the nation better than the former. And this brings me to the fundamental theme of my oration. It is this: That the best preparation for success in any calling is the training of the student in methods of research. This should be the goal to be clearly kept in view by all teachers in the philosophical faculties of universities. They should teach with this object: To awaken in their students a love of their subject and a consciousness that if he persevere, he, too, will be able to extend its bounds.

Of course, it is necessary for the student to learn, so far as is possible, what has already been done. I would not urge that a young man should not master, or at all events learn, a great deal of what has been already discovered before he attempts to soar on his own wings. But there is all the difference in the world between the point of view of the student who reads in order to qualify for an examination, or to gain a prize or a scholarship, and the student who reads because he knows that thus he will acquire knowledge which may be used as a basis of new knowledge. It is that spirit in which our universities in England are so lamentably deficient; it is that spirit which has contributed to the success of the Teutonic nations, and which is beginning to influence the United States. For this condition of things our examinational system is largely to blame; originally started to cure the abuses of our civil service, it has eaten into the vitals of our educational system like a canker, and it is fostered by the further abuse of awarding scholarships as the results of examinations. The pauperization of the richer classes is a crying evil; it must some day be cured. Let scholarships be awarded to those who need them, not to those whose fathers can well afford to pay for the education of their children. "Pot-hunting" and philosophy have absolutely nothing in common.

It follows that the teachers in the philosophical faculty should be selected only from those who are themselves contributing to the advancement of knowledge; for if they have not the spirit of research in them, how shall they instill it into others? It is our carelessness in this respect (I do not speak of University College, which has always been guided by these principles, but of our country as a whole) which has made us so backward as compared with some other nations. It is this which has made the vast majority of our statesmen so careless, because so ignorant, of the whole frame of mind of the philosopher, and which has made it possible for a man high in the political estimation of his countrymen to address on a recent occasion the remarks which he did to graduates of our university. It is true that one of the functions of a university is to "train men and women fit for the manifold requirements of the Empire;" that we should all heartily acknowledge; but no man who has any claim to university culture can possibly be contented if the university does not annually produce much work of research. It is its chief excuse for existence; a university which does not increase knowledge is no university; it may be a technical school, it may be an examining board, it may be a coaching establishment, but it has no claim to the name university. The best way of fitting young men for the

manifold requirements of the Empire is to give them the power of advancing knowledge.

It may be said that many persons are incapable of exhibiting originality. I doubt it. There are many degrees of originality, as there are many degrees in rhyming, from the writer of doggerel to the poet, or many degrees of musical ear, from the man who knows two tunes, the tune of "God Save the King" and the *other* tune, to the accomplished musician. But in almost all cases, if caught young the human being can be trained, more or less, and, as a matter of fact, natural selection plays its part. Those young men and women who have no natural aptitude for such work—and they are usually known by the lack of interest they take in it—do not come to the university. My experience is that the majority, or at least a fair percentage of those who do come, possess germs of the faculty of originating, germs capable of development, in many instances, to a very high degree. It is such persons who are of most value to the country; it is from them that advance in literature and in science is to be expected, and many of them will contribute to the commercial prosperity of the country. We hear much nowadays of technical education; huge sums of money are being annually expended on the scrappy scientific education in evening classes of men who have passed a hard day in manual labor, men who lack the previous training necessary to enable them to profit by such instruction. It may be that it is desirable to provide such intellectual relaxation; I even grant that such means may gradually raise the intellectual level of the country; but the investment of money in promoting such schemes is not the one likely to bear the most immediate and remunerative fruit. The universities should be the technical schools; for the man who has learned to investigate can bring his talents to bear on any subject brought under his notice, and it is on the advance, and not the mere dissemination, of knowledge that the prosperity of a country depends. To learn to investigate requires a long and hard apprenticeship; the power cannot be acquired by an odd hour spent now and again; it is as difficult to become a successful investigator as a successful barrister or doctor, and it requires at least as hard application and as long a period of study.

I do not believe that it is possible for young men or women to devote sufficient time during the evening to such work. Those who devote their evening hours to study and investigation do not bring fresh brains to bear on the subject; they are already fatigued by a long day's work; and, moreover, it is the custom in most of the colleges which have evening classes to insist upon their teachers doing a certain share of day work; they, too, are not in a fit state to direct the work of their pupils or to make suggestions as to the best method of carrying it out. Moreover, the official evening class is from 7 to 10 o'clock, and for investigation in science a spell of three hours at a time is barely sufficient to carry out successfully the end in view; indeed, an eight hours' day might profitably be lengthened into a twelve hours' day, as it not infrequently is. It is heartrending in the middle of some important experiment to be obliged to close and postpone it till a future occasion, when much of the work must necessarily be done over again.

These are some of the reasons why I doubt whether university education, in the philosophical faculty at least, can be successfully given by means of evening classes.

Although my work has lain almost entirely in the domain of science, I should be the last man not to do my best to encourage research in the sphere of what is generally called "arts." In Germany of recent years a kind of institution has sprung up which is termed a *Seminar*. The word may be translated a "literary laboratory." I will endeavor to give a short sketch on the way in which these literary laboratories are conducted. After the student has attended a course of lectures on the subjects to which he intends to devote himself and is ripe for research, he enters a seminar, in which he is provided with a library, paper, pens, and ink and a subject. The method of using the library is pointed out to him, and he is told to read books which bear on the particular subject in question; he is made to collate the information which he gains by reading, and to elaborate the subject which is given him. Naturally his first efforts must be crude, but "*c'est le premier pas qui coûte*." It probably costs him blame at the hands of his instructor; after a few unsuccessful efforts, however, if he has any talent for the particular investigation to which he has devoted himself, his efforts improve and at last he produces something respectable enough to merit publication. Thus he is exposed to the criticism of those best competent to judge, and he is launched in what may be a career in historical, literary, or economic research.

Such a seminar is carried on in philological and linguistic studies, in problems of economy involving statistics, in problems of law involving judicial decision, and of history in which the relations between the development of the various phases in the progress of nations is traced. The system is borrowed from the well-known plan of instruction in a physical or chemical laboratory. Experiments are made in literary style. These experiments are subjected to the criticism of the teacher, and thus the investigator is trained. But it may be objected that the youths who frequent our universities have not a sufficient knowledge of facts connected with such subjects to be capable of at once entering on a training of this kind. That may be so; if it is the case, our schools must look to it that they provide sufficient training. Even under present circumstances, however, I do not think I am mistaken in supposing that a young man or woman who enters a university at the age of eighteen years with the intention of spending three years in literary or historical studies will not at the end of the second year be more benefited by a course at the seminar, even though it should result in no permanent addition to literature or history, than if he were to spend his time in mere assimilation. It is not the act of gaining knowledge which profits, it is the power of using it, and while in order to use knowledge it is necessary to gain it, yet a training in the method of using knowledge is much more important and profitable than a training in the method of gaining it. I do not know whether there exists in this country a single example of the continental seminar; there was some talk of founding such a literary laboratory in University College, but, as usual, the attempt was frustrated by a lack of funds; the attempt would also have been frustrated by the requirements of the present system of examination in the University of London; but there is, fortunately, good hope of changing that system and of developing the minds of students on those lines which have proved so fruitful where they have been systematically followed.

Many, I suppose, who are at present listening to me would be disappointed were I not to refer to the functions of a university with reference to examinations. A long course of training, lasting now for the best part of seventy years, has convinced the population of London that the chief function of a university is to examine. Believe me, the examination should play only a secondary part in the work of a university. It is necessary to test the acquirements of the students whom the teachers have under their charge, but the examination should play an entirely subordinate part. To aim at success in examinations is, unfortunately, too often the goal which the young student aims at, but it is one which all philosophical teachers deprecate. To infuse into his pupils a love of the subject which both are at the same time teaching and learning is the chief object of an enthusiastic teacher; there should be an atmosphere of the subject surrounding them—an umbra—perhaps I should call it an aura; for it should exert no depressing influence upon them. The object of both classes of students (for I count the teacher a student) should be to do their best to increase knowledge of the subject on which they are engaged. That this is possible many teachers can testify to by experience; and it is the chief lesson learned by a sojourn in a German laboratory. Where each student is himself engaged in research, interest is taken by the students in each others' work; numerous discussions are raised regarding each questionable point; and the combined intelligence of the whole laboratory is focused on the elucidation of some difficult problem. There is nothing more painful to witness than a dull and decorous laboratory, where each student keeps to his own bench, does not communicate with his fellow-students, does not take an interest in their work and expects them to manifest no interest in his. It is only by friction that heat can be produced, and heat, by increasing the frequency of vibration, results, as we know, in light.

The student should look forward to his examination, not as a solemn ordeal which he is compelled to go through with the prospect of a degree should he be successful, but as a means of showing his teacher and his fellows how much he has profited by the work which he has done; those who pursue knowledge in this spirit and those, be it remarked, who examine in this spirit will look forward to examination with no apprehension; not, perhaps, with joy, for after all it is a bore to be examined and perhaps a still greater bore to examine, but it is a necessary step for the student in gaining self-assurance and the conviction of having profited by his exertions, and for the teacher as a means of insuring that his instruction has not been profitless to his student. In this connection I cannot refrain from remarking that that genius for competition which has overridden our nation of England appears to me to be misplaced. Far too much is thought of the top man; very likely the second or even the tenth, or it may be the fiftieth, has a firmer grasp of his subject and in the long run would display more talent. Let us take comfort, however, in the thought that the day of examinations, for the sake of examinations, is approaching an end.

It may surprise many to learn that the suggestion that in England teachers do not usually examine their own pupils for degrees is, abroad, received in a spirit of surprise not unmixed with incredulity. Americans and Germans to whom I have mentioned this state of matters cannot realize that the teacher is not considered fit to be trusted to examine his own pupils, and, singular to state, they maintain that no one else can possibly do so with any attempt at fairness; it appears to them, as it appears to me, an altogether untenable position to hold that a man selected to fill an important professorship, after many years' trial in a junior position, should be suspected of such (shall I say) ambiguous ideas regarding common honesty that he will always arbitrate unfairly in favor of his own pupils. Such a supposition is an insult to the professor, and the exclusion of the teacher elevates examination to the position of a fetish; it is that, together with the spirit of emulation and competition, which has done so much to ruin our English education. The idea of competitive examination is so ingrained in the minds of Englishmen that it is difficult for them to realize that the object of a university is, not primarily to examine its pupils, but to teach them to teach themselves; and also they have still to acquire the conviction that students should be found, not merely among the *alumni* of the university, but also among all members of the staff. The spirit which should prevail with us should be the spirit of gaining knowledge—gaining knowledge, not for the satisfaction of one's own sense of acquisitiveness, but in order to be able to increase the sum total of what is known. All should work together, senior and junior staff, graduates and undergraduates, in order to diminish man's ignorance.

To sum up. As it exists at present, a university is a technical school for theology, law, medicine, and engineering. It ought to be also a place for the advancement of knowledge, for the training of philosophers, of those who love wisdom for its own sake; and while as a technical school it exercises a useful function in preparing many men and women for their calling in life, its philosophical faculty should impart to those who enter its halls that faculty of increasing knowledge which cannot fail to be profitable, not only to the intellect of the nation, but also to its industrial prosperity. I regard this as the chief function of a university.

THE FUTURE COALING STATIONS OF THE UNITED STATES.

From a French Point of View.

WHAT is called "imperialistic" politics is now reigning in a very manifest and marked manner among at least four of the great powers of the globe—England, Germany, Russia and the United States. It is, perhaps, in the latter country that it has been manifesting itself with the most intensity during the last few years.

The conquest of Cuba, Porto Rico and the Philippines and their dependencies, the absorption of the Hawaiian Islands, and the division of the Samoan Islands, very far from having exhausted the fever of expansion which is at present agitating the great American Republic, seem, on the contrary, to have superexcited it, if we are to judge from the measures

MAP SHOWING CHAIN OF UNITED STATES COALING STATIONS.

that it is taking to follow up its first successes, which were so easy and so rapid.

By their own experience during the Hispano-American war, as well as by the example of England, which, thanks solely to the prestige of its powerful navy, has been able to immobilize nearly all of its land troops in a distant war, the United States have realized that the naval factor is now playing a leading part in the conflicts between nations, and are endeavoring to give their war fleet a greater and greater importance. But a fleet that may be called upon to operate, if occasion requires it, upon the vast chess board of the globe must have points of support and supplies.

The question of coaling stations, especially, is a preponderant one, since a ship without coal becomes as useless as a gun without cartridges; and since coal is at present rightly regarded as contraband of war, so the question of coal depots has become the principal preoccupation of the United States Navy Department.

Some information recently sent from Washington to London and published in the daily papers is, from this viewpoint, particularly suggestive. The following is the text of it:

"The government of the United States is disposed to put in execution a project for the establishment of a chain of coaling stations all around the globe. Negotiations are in progress with Portugal for the acquisition of one of the Azores, with Holland for that of a part of the island of Curacao, and with Ecuador for that of one of the Galapagos Islands."

The United States do not wish merely the authority to establish coaling stations, but desire also to obtain sovereign rights over such stations. They have already obtained the right to establish stations at Yokohama and Pitcher Lake, near La Paz, Mexico, and are at work constructing depots at Honolulu, Tutuila (Samoa) and Guam. Cavite and Manila will soon be transformed into coal ports. This makes, in all, ten coaling stations—two in the Atlantic and eight in the Pacific.

As regards the present possessions of the United States—Honolulu, Samoa, Guam, Cavite and Manila—we may consider these five coal depots as acquired. But although the United States have obtained the right to establish coal depots at Yokohama (Japan) and Pitcher Lake, it is more than doubtful whether they have at the same time obtained sovereign rights over these points. The same doubt exists regarding the stations

projected on the Galapagos, at Curacao, and in the Azores. Moreover, it cannot be denied that the situation of these depots is well selected. A station in the Galapagos would admirably complete the quadrilateral of Honolulu, Samoa, Pitcher Lake and Curacao, and would prolong the Cuba and Porto Rico line. Finally, a station in the Azores, in the vicinity of Europe, would permit the American navy more and more effectively to intervene in the affairs of the old continent. So we have little faith that it will be acquired. Portugal has nothing to gain and everything to lose in facilitating the approach of the power of the United States.

However this may be, it is well that public attention should be directed to these new acts of the United States, for which the Monroe Doctrine no longer seems to suffice and which are extending more and more menacing tentacles in every direction.

Cartographers are in no haste to paint new archipelagoes with the American colors.—A Travers le Monde.

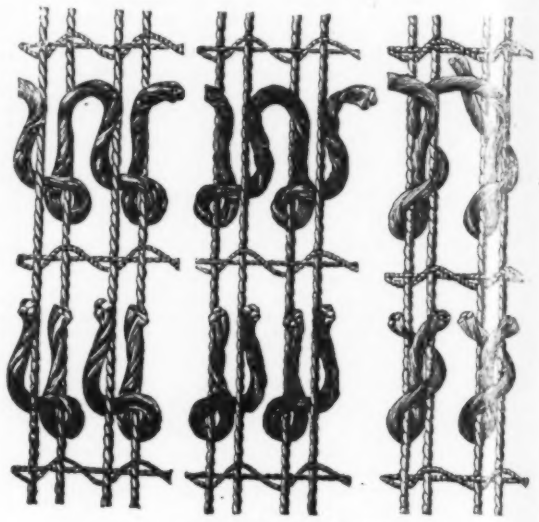
ORIENTAL RUG-WEAVING.

In Persia, where rug-weaving, after a long period of development, is now in a state of artistic decline, rugs are made after old patterns in the simplest designs. The carpet weavers may be divided into two classes. Those who have a fixed place of business, and those who journey from place to place. The former erect vertical looms during the winter in their houses, and during the summer they work in the courtyard. The journeymen weavers, as a general rule, employ horizontal looms. The Persian loom composed of rough beams consists of two upright posts secured to the floor and to a ceiling beam. Two horizontal timbers carry the chain. Opposite the row of upright posts a ladder is placed, over the rounds of which beams are laid to serve as movable seats for the weavers. As a general rule, the weaving is performed by women. The loom is the property of a man; the weavers are his wives and his daughters. Among the Turks a suitor pays the father of the girl whom he wishes to wed or her guardian a hundred toman ($130 to $150). If the husband dies, his widow, if she marries again, is worth 200 toman; if she marries a third time her value is increased to 300 toman. The increase in price is due to the increase in experience of the woman in domestic matters and in the art of weaving. The province of Iriz produces by far the larger quantity of Persian rugs sold in European markets. Some 150 villages, with 5,000 looms, are busily engaged in producing rugs. Each year about 4,000 rugs are made. Each rug represents a half year's hard work. A hired weaver earns about 1½ shillings per week—rather poor pay if it be considered that each square foot of a fine prayer rug represents about 40,000 meshes.

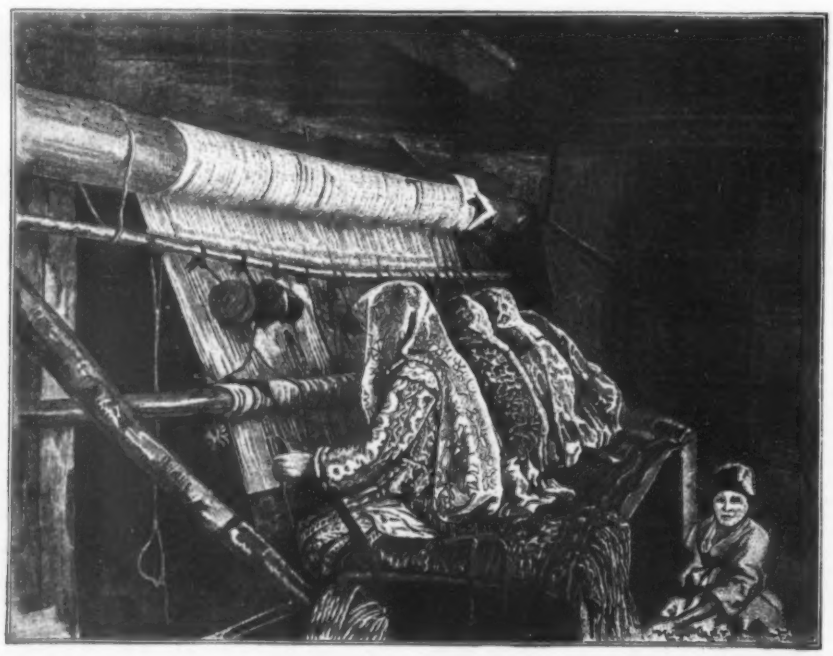
In India the designs are more varied and are more boldly handled than in Persia. The tree of life, the cyprus, the lotus flower, the date palm, the dragon, the phœnix, and other fabulous animals constitute the basic principle of most Indian designs. The method of weaving and the wage of weaving are the same as in Persia. It should be mentioned that the Indian government has succeeded in introducing rug-weaving into its prisons with considerable success. In Asia Minor, in the Province of Aidin, carpet weaving and rug-weaving is often of more importance than in Persia or India. The city of Uschak, a town of 25,000 inhabitants, has 1,000 looms operated by 9,000 weavers. Each year rugs to the value of 3,500,000 francs are produced, woven by women who earn but 4, at the most 8, francs per week. In the little town of Guyordes and vicinity there are about 350 looms in constant operation, which produce each year rugs to the value of 800,000 francs. The product of the city of Kula is worth about 400,000 francs annually.

The steps in the making of the so-called Smyrna rugs are the following: The Persian carpet is formed by knotting into warp, tuft after tuft of woolen yarn, over each row of which a woof shot is placed, the fingers being employed instead of the shuttle needles, since the fabric is coarse. The warp threads are arranged in the loom in parallel order, whether upright or horizontal, and the fabric and pattern are produced by colored threads hand-wrought upon the warp. In Aidin the carpets are woven in one piece. Their manufacture is peculiar, in so far as the same pattern is never again exactly reproduced. No two carpets are quite alike. The colors are rich, harmonious, red or green being the usual ground colors with blues, yellows and black, but very rarely is any white permitted to appear. The design is usually made up of a large center of more or less diamond pattern, with smaller diamonds filling up the corners and inside, the whole surrounded with a border of lines of different colors. The peculiarities of the patterns have been accounted for by the theory that the Turkish carpet represents inlaid jewel work, which accords with the Oriental delight in jewels and precious stones.

COMBING THE WOOL.



KNOTTED STRANDS.



A SMYRNA LOOM.

THE AFRICAN FOREST.

By GEORGE L. BATES.

THE inexhaustible wonder of this country is the forest. It never grows familiar.

The forest is not a region apart, but extends everywhere without a break, except where it has been cleared by man for his gardens and villages, or cleft by a river too wide for it to meet and close over from the two banks. This part of our planet has a double surface—the real, solid one underneath, and the leafy one above. Men traverse the solid surface as if by tunnels in a subterranean region. Paths run from village to village under the forest, like those of meadow mice under the grass.

Mankind is limited to the real earth's surface, and can have only distant knowledge of the world in the tree-tops. That is mostly out of his sight. But the traveler marching along the forest path often sees and hears things to remind him of this upper world apart. He hears the screams of parrots invisible overhead, hunting in the tree-tops for fruits that he cannot see from below. He hears a confusion of rushing sounds like the arrival and departure of trains at a metropolitan station, and learns at length that it is made by the long, loosely plumed wings of hornbills, flying from tree to tree as they feed. Here and there the path is whitened by petals fallen from somewhere above. It is useless to try to tell which tree or vine in the tangle has borne them. Where a big tree has fallen, carrying with it all its dependent vines and connected smaller trees, a rift is made. Here the eyes, adjusted to the sub-sylvan twilight, are dazzled by a flood of sunshine. On the limbs of the fallen tree are seen growing and blossoming pendent orchids and other air-plants, specimens from the flora of the upper region. One seldom sees a bird's nest in this country; the birds have their homes in the world above man's view.

While man sees this upper world at a distance, or not at all, his nearest animal relations can not only reach it, but are at home in it. One may hear the cries of monkeys above him, and the rustling of the branches as they scamper away from tree-top to tree-top, faster than he can follow on the ground. But to catch a glimpse of them is not so easy. One may, perhaps, be shown by a native guide some leafy bed in the branches above and be told that chimpanzees have slept there.

Nor are monkeys and lemurs the only arboreal animals. The forest is a paradise for squirrels, of which there are eight or nine species, of all colors and sizes, down to the little pygmy squirrel, the size of your thumb. Besides, there is a whole peculiar family of scale tail flying squirrels, with a sort of hob-nails on the under side of the tail, to help them climb or jump. The cats, from the leopard down, climb trees.

A WOODEN COMB.

The awkward coney manages in some way to ascend hollow or slanting trees, and his evening and morning cry is heard from the upper region, though he comes down to the lower to feed. Even snakes are seen as often overhead as on the ground.

Except where the path goes, the under world is not much more accessible than the upper, at least to the white man, who doesn't know how to twist in and out

among thorny vines. The little antelopes, the wild hog and the porcupine can slip about in the universal thicket, and the elephant crashes through it, uprooting a sapling here and there, and leaving a broad path behind him. But these animals are seldom seen or heard. In general there is lonely silence below the forest.

It is gloomy and dark on this lower deck of the tropical world. The sunshine, birds and flowers are mostly far overhead. But one sometimes meets delightful surprises, for there is beauty even here. Several kinds of trees and shrubs have a way of putting forth blossoms right out of the trunk. There are flowers set right on the damp, black bark, as yellow as Dakota sunflowers—so flaming that they seem to light up the gloom. Again, at the right season, one may find clusters of blood-red fruit, growing low down on the trunks of trees. But these bits of brightness are only occasional. For the most part all is black, damp and decaying.

The loneliness of the forest is oppressive. After a half-day's tramp between two settlements there is no more welcome sight than a garden clearing, showing that human habitations are not far off. Then the two rows of smoky tumble-down huts with the yellow clay street between that form the village are a gladdening view, for they are the dwellings of one's own kind.

The sense of the omnipresence of the forest appears in the speech of the men who inhabit it. To go astray, or aside, in the Fang language, is to go "into the forest." To throw a thing away is to throw it "a-forest." To arrive at a place is to "come out" or "emerge," while to set forth from a place is to "enter." It is not necessary to add what is entered or come out from.

As evident in the character of the people is an inborn revulsion against the loneliness of the forest. The ideal village, to them, is perfectly cleared of vegetation. Shade trees have no attractions for them. To travel alone, and especially to sleep alone, in the forest is a hardship, not so much on account of any danger as on account of the loneliness. A favorite name for a village means "Noise-of-People." The hubbub of talking and singing and drumming in the village street is dear to the heart of a Fang, for in it he forgets the great black forest.

Only the Dwarf tribe, occasionally met with in this country, seem to be entirely reconciled to the forest. Only they are content to live in booths of leaves, hunting the game of the forest depths with an hereditary keenness that is almost instinct.—Benito, Congo Francais.—The Independent.

MECHANISM OF THE SANTOS-DUMONT BALLOON.

The progress made by the automobile industry during the last few years in the construction of the gasoline motor has rendered the latter the best for aerial locomotion; and Signor Santos-Dumont, like Count Zeppelin and other German aeronauts, has adopted it for his new balloon. His motor is of the Buchet system, with four parallel cylinders, electric sparking and cooling by flanges. It is of a nominal 16 horse power at 1,000 revolutions. A cylindrical reservoir permits of carrying a supply of five gallons of gasoline, assuring a trip of about five or six hours.

The great velocity of the motor necessitates the intercalation of a reduction gearing that brings the number of revolutions to between 150 and 200. The screw, the shaft of which rests upon suspended bearings, has two blades formed of gummed silk tightly stretched over a light steel frame. It is 13 feet in diameter and of 13 feet pitch. Running at 200 revolutions, it produces a tractive stress of 176 pounds.

The steering apparatus is a triangular rudder of cloth placed between the balloon and the keel, and the center of action of which is about 39 feet from amidships.

Of course, all the controlling mechanisms of these parts run to the station of the steersman, who has also within reach a small winch that permits him to maneuver a guide rope. This is a cable passing under the keel and allowing its two free bights to hang at the two extremities. Upon acting on the winch, it is possible to displace the entire cable in elongating one of the bights and shortening the other, so as to modify the distribution of the weight and permit of regulating the inclination of the balloon. The guide rope weighs 84 pounds, while the keel and the entire mechanical part do not exceed 550.

The ascensions of the 12th and 15th of July permitted of ascertaining how the balloon behaves itself in the air—at least in calm air, since the velocity of the wind does not appear to have exceeded more than 8 or 10 feet per second. The balloon obeyed the rudder properly and kept well under way. In a vertical plane, the pitching was quite marked and would have become dangerous with an increase of speed or in case of a squall.

One of the drawbacks of the gasoline motor is that it imparts strong vibrations to the frame upon which it rests. The essential thing is that such vibrations shall not be exaggeratedly transmitted to the balloon itself.

It does not seem that the balloon developed a velocity greater than about twenty feet. It is to be regretted, moreover, that Signor Santos-Dumont was not able to measure his velocity directly. For this purpose there exists the log-balloon, which, although it does not offer absolute accuracy, gives at least an approximate result. But Signor Santos-Dumont was alone in his car and could not do everything.—For the above particulars and the engravings, we are indebted to La Nature.

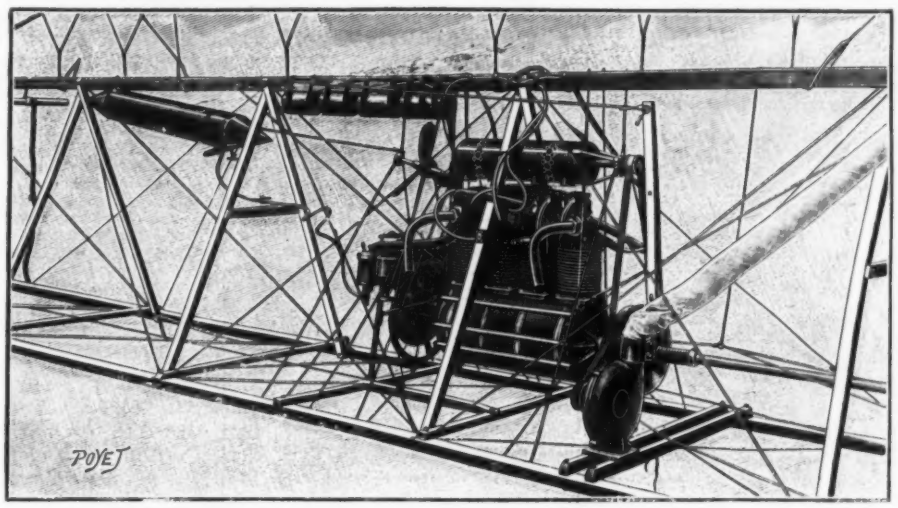


FIG. 1.—THE MOTOR OF THE SANTOS-DUMONT BALLOON No. 5.

To the left are the induction coils and the reservoir of gasoline. To the right is the blower for inflating the small balloon. Above are the starting gear and propeller shaft. In front are the exhaust pipes, cylinders and piston rod.

American Competition in Austria-Hungary.—In all the recent efforts of Austria-Hungary to further its export trade, repeated mention has been made of the danger of American competition in this monarchy. Germany exports more to Austria-Hungary than any other nation. For the year 1900, merchandise to the value of some $127,000,000 was sent from Germany to Austria-Hungary, while, on the other hand, the exports of Austria-Hungary to Germany amounted to some $188,300,000. Countries exporting to Austria-Hungary are, in the order of the amounts exported, as follows: Germany, United States, England, Italy, Russia, British India, Switzerland, France, and Brazil. It will be noticed that the United States occupies the second place. This fact, accepted without further investigation, really suggests more than it should. There is a vast difference in the figures for Germany and those for the United States. While Germany sent into Austria-Hungary, during 1900, $127,000,000 worth of goods, the exports of the United States to Austria-Hungary amounted to about $30,600,000. The circumstance causing the chief dissatisfaction in this monarchy in regard to our reciprocal trade is found in the fact that the United States comes ninth in the list of countries to which Austria-Hungary exports, the monarchy having sent to us in 1900 products to the value of $7,600,000, which is an increase over the previous year of about $1,150,000, and the greatest amount exported to the United States from Austria-Hungary during the past eight years.

One hears much in manufacturing circles in Austria-Hungary of the "American danger." A measure to exclude American canned meats is demanded by Austrian manufacturers and economists, who claim that inasmuch as Germany has prohibited the importation of certain meats in air-tight cans and barrels, which acts chiefly on American shipments in this line, American packers, losing a market in the German Empire, should be hindered from increasing their sales in Austria-Hungary. American shoes are about to be extensively launched on the Austrian market, and as a consequence, the shoemakers' guild in Vienna is sending a deputation to the government to petition that measures be taken to prevent the American competition. Especial mention is made of tacks, which Austria has exported in large quantities profitably to the Levant, India, and Japan. American manufacturers can now offer them at a price that much impairs the Austrian industry in this line, and almost excludes further business. One well-known Austrian manufacturer advocates the formation of trusts in Austria on American principles. The supposed American peril is touched upon in all discussions concerning the strengthening and expansion of Austrian commerce. In debating in Parliament the important bill for the construction of a system of canals in Austria, frequent reference was made to the growth and power of the United States and the danger of its competition in this monarchy.—Carl Bailey Hurst, Consul-General at Vienna.

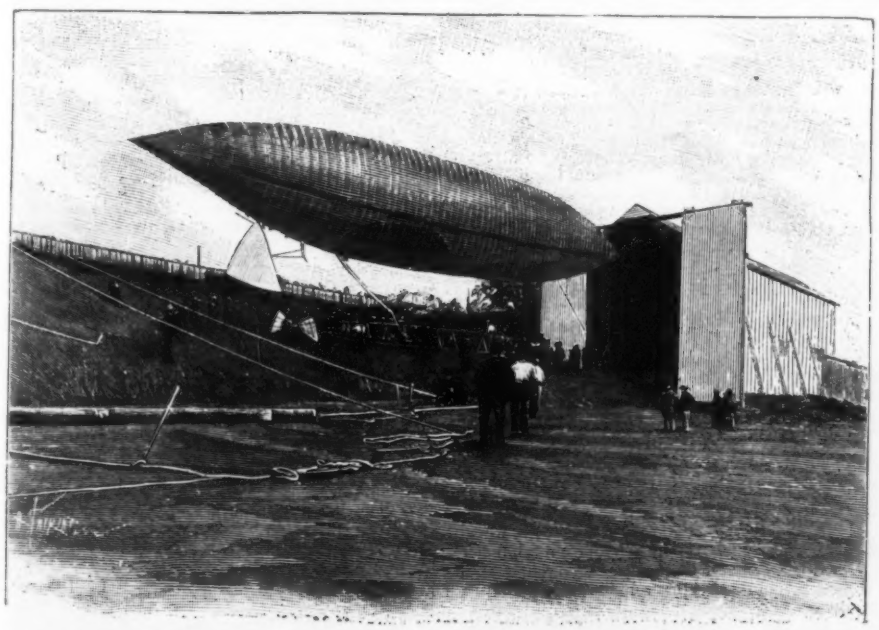


FIG. 2.—THE BALLOON MAKING ITS EXIT FROM THE SHED OF THE AERO CLUB. HILLS OF SAINT CLOUD.

CONTEMPORARY ELECTRICAL SCIENCE.*

HERTZIAN WAVES IN THUNDERSTORMS.—The influence which thunderstorms exercise at a distance of thousands of miles upon persons affected by certain nervous diseases, long before any physical instrument announces an atmospheric disturbance, suggested to F. Larroque that Hertzian waves emitted by thunderstorms might possibly be propagated over enormous distances through the middle and higher atmosphere by means of something corresponding to relays. He, therefore, constructed an elementary kind of "receiver" in the shape of a horizontal plate of zinc, 40 cm. in diameter, earthed by a thin copper wire containing a spark gap in a dark cellar. During the great atmospheric disturbances of June, 1901, several series of nocturnal observations were made. One of them coincided with the blizzard in the Grampians, and the other was carried out during a thunderstorm which, in the night of June 18, was visible over Corsica from the Département des Alpes Maritimes. In both cases the sky was serene at the place of observation. The author points out the great importance which this kind of meteorology may acquire, without, however, venturing an explanation of the actual transmission of Hertzian waves over the enormous distances specified.—F. Larroque, Comptes Rendus, July 1, 1901.

EFFECT OF ANNEALING UPON X-RAY TRANSPARENCY.—Faraday observed that a sheet of silver or gold foil could be annealed in such a manner as to lose its metallic reflection and become transparent to white light, subsequently regaining its original state on being compressed between two slabs of agate. This curious observation has not been explained, but R. Malagoli has made observations on plates of gold and silver, with a view of determining whether similar modifications of transparency could be produced with respect to Röntgen rays. In most cases the annealed plates underwent a slight increase of opacity. The same observation was made in the case of gold or silver foil. But when the latter was used in the form of some 50 sheets pressed together a great increase of transparency was observed. This is the exact equivalent of Faraday's effect. It is probably explained by differences of physical structure, which, in the case of plates and uncompressed films, produce an increased surface reflection, and in the case of compressed films, a decreased surface reflection. That the action in question is a surface effect is made very probable by the disappearance of surface color in Faraday's experiment.—R. Malagoli, N. Cimento, June, 1901.

CALORIMETRIC MEASUREMENTS OF ELECTRIC OSCILLA-

*Compiled by E. E. Fournier d'Albe in The Electrician.

TIONS.—F. Harms made some experiments with the bridge arrangement for rapid electric oscillations suggested by Nernst. Working with waves 10 m. long, he found that in the case of alcohol the telephone minimum became very bad—much worse, indeed, than in the case of substances conducting one hundred times better. This could only be due to anomalous absorption in alcohol. The author therefore employed a calorimetric method for proving the existence of such absorption. The difference between the observed evolution of heat and that calculated from the resistance would be the heat of absorption. If, on the other hand, Ohm's law is to preserve its validity in the domain of anomalous absorption, the resistivity must be taken as varying with the frequency. The author used a bulb provided with platinum electrodes and a narrow thermometer tube, and proved the existence of anomalous absorption in five different alcohols. The anomalous absorption, regarded as an increase in the conductivity, may be used for calculating the anomalous index of absorption with and of the formulæ used for calculating the normal index of absorption from the electrolytic conductivity.—F. Harms, Ann. der Physik, No. 7, 1901.

NATURAL AND RADIO-ACTIVE AIR.—J. Elster and H. Geitel find a number of analogies between air in its natural state and air which has been blown over radio-active substances. Such air imparts to other substances a temporary radio-activity, which can be considerably enhanced by giving those other substances a negative charge during exposure to the air. A similar kind of radio-activity may be produced by ordinary air. It is only necessary to expose, say, a negatively charged piece of wire gauze for several hours to the open air. The wire gauze then behaves like a body of feeble but distinct radio-activity. It imparts electric conductivity to air, even across a piece of aluminium foil, and the authors claim even to have obtained photographic effects. The natural conclusion is that, wherever the potential gradient of the atmosphere produces a negative charge of the earth (as on mountain tops), there must exist a radio-activity of the earth and an increased conductivity of the air above it. The author's researches leave it an open question whether this "emanation" of the air is due to its known constituents or to a radio-active gas unknown. In any case, there is an attractive field for further investigation.—Elster and Geitel, Phys. Zeitschr., July 6, 1901.

SPACE TELEGRAPHY.—Skunkichi Kimura, a Japanese naval electrician, has made some valuable researches on the influence of the earth on wireless signaling. This influence cannot be determined by means of the Marconi apparatus, since neither the coherer itself nor its tapping mechanism works uniformly. The author therefore employed his sound "receiver," which indicates all variations of the current by variations of the intensity, sharpness, or duration of the tone. He used five different earth contacts for the mast-wire, comprising plates, cylinders, and wires of various materials and dimensions. The best results were obtained with a tin cylinder put in a ground saturated with sea water. The author believes that the earth connection works by its capacity rather than its conductivity, and a large earthing plate is therefore advantageous. Signals over 50 miles were obtained with an earthing device consisting of three oil cans placed on grass. He points out that the induced E.M.F. cannot be the sole cause of the decrease of resistance in the coherer, and that a node of potential cannot exist at the other end. The problem of "tuning" must in any case take into account the capacity of the earthing arrangement.—S. Kimura, Phys. Zeitschr., June 29, 1901.

ELECTRICAL BLACK BODY.—O. Lummer and F. Kuribaum describe their electrically heated "ideal black body," with which they proved that the total radiation of such a body is proportional to the fourth power of the absolute temperature. It consists of a double cylinder, the outer one being of platinum, which is electrically heated, while the inner one is of porcelain lined with a mixture of chromium, nickel and cobalt oxides, which resists temperatures of over 1,500 deg. A thermocouple is introduced into the center of the inner tube to determine its temperature. A series of diaphragms, getting narrower toward the end, lines the same tube. Thus the essential condition is fulfilled of having a hollow body with walls at a uniform temperature. If necessary, the inner tube is surrounded by two successive air chambers, the last being contained in an asbestos tube. Then a temperature of 1,560 deg. may be obtained with a current of less than 100 amperes. At that point the porcelain used by the royal Prussian porcelain factory begins to soften and acquire a conductivity which interferes with the readings of the thermocouple.—Lummer and Kuribaum, Ann. der Physik, No. 8, 1901.

MAGNETIC ACTION OF CATHODE RAYS.—Since the time of Hertz, it has been believed that though a magnet exerts a deflecting action upon a beam of cathode rays, the latter does not exert any corresponding action upon a magnet. There is an action, in fact, without a reaction. It has been explained by supposing that the return stream of cathode particles exactly neutralizes the action exerted by the cathode beam. Even if, as in Hertz's experiment, the cathode beam filled practically the whole of the tube, the return stream might pass along the wall and constitute an "inductionless winding." If in such a case, a small magnet could be suspended in the cathode stream itself, it would probably show some deflection. That this is actually the case has been proved by J. von Geitler. He suspended a small magnet in a long and wide tube, in the center of the stream, and found a deflection such as would have been produced by the current passing if an ordinary conductor had been substituted for the tube. On bringing the magnet near the walls of the tube, a contrary deflection was observed. This at once suggests the return stream, but the author wisely refrains from straightway adopting this obvious inference.—J. von Geitler, Ann. der Physik., No. 8, 1901.

MAGNETIC ELEMENTS AT GEOLOGICAL EPOCHS.—Our knowledge of the earth's magnetization at remote periods is likely to experience an enormous expansion by the researches instituted by B. Brunhes and P. David. Encouraged by the success achieved by Folgheraiter in determining the magnetic dip of 3,000 years ago from Tuscan vases, the authors applied the same principle to geological deposits. It is known that clay at the time of baking is magnetized in the direction of the earth's field, and keeps that magnetization for untold ages after cooling. An analogous case in nature occurs when a stream of lava traverses a bed of clay. A layer 2 or 3 yards thick is baked into a hard mass, which has the advantage over the Tuscan vases of retaining its orientation, so that not only the dip but the magnetic declination may be found. The authors actually found a well-defined magnetization, different from the earth's field, in some cubes of such clay situated near the Puy-de-Dome. The dip was 56 deg. 30 min., and the declination 7 deg. to the east of the present compass. It now remains to determine the age of the eruption. Incidentally, we obtain a test of the contemporary nature of the two lava flows.—B. Brunhes and P. David, Comptes Rendus, July 15, 1901.

ANALOGY BETWEEN NERNST BODIES AND GASES.—W. Kaufmann has shown that the electrodynamic behavior of conducting gases may be deduced from an empirical curve, $E = f(I)$, the so-called "characteristic," where E denotes the E.M.F. at the ends of the gaseous interval, and I the current intensity. For stability of equilibrium, the condition

$$W > -\frac{\sigma E}{\sigma I}$$

must be observed, W being the resistance of the remainder of the circuit. Since these results are obtained independently of the unknown mechanism of discharge, it follows that they must be applicable to any conductor whatever. Thus a solid body possessing a "characteristic" similar to that of a gas must show the same peculiarities, such as discharge potentials, minimum currents, and intermittent discharges. The author proves the existence of these peculiarities in a Nernst glow-body, and shows, incidentally, that the instability of the discharge at the point where the spark potential is reached is purely electrodynamic and has nothing to do with the inner mechanism of gaseous conduction. The "characteristic" of a Nernst body is

$$E/I = c\left(\frac{EI}{k} + T_0\right)^{-n}$$

where $\log c = 53.18$, $k = 966$, and $n = 18.2$. The resistance and temperature curve show no singularities.—W. Kaufmann, Ann. der Physik, No. 8, 1901.

ELECTRIC SUCTION.—The blackening of a field of buckwheat blossoms by a thunderstorm is a well-known but hitherto unexplained phenomenon. The researches of Selim Lemström on the transport of water in capillary tubes under the influence of an electric current passing through the surrounding air shed a new light upon it. The author mounted a capillary tube in a beaker full of water, which was joined to earth. At a few centimeters above the capillary tube he fixed the pointed negative pole of an influence machine whose positive pole was put to earth. When the machine was worked water was sucked up along the walls of the tube, and formed drops near the top. The formation of drops is observed even when the distance between the pole and the level of the water is 75 cm. The suction of water continues at even greater distances. The amount of water sucked up is proportional to the current intensity, and that, again, is inversely proportional to the square of the distance between the point and the meniscus. The amount is also, for the first three minutes or so, proportional to the duration of the current. Salt solutions act like water when dilute, but the amount sucked up is smaller. The connection with plant life is obvious, since all the vegetable humors rise through capillary tubes. The explanation must be connected with the transport of material particles in liquids described by Quincke.—S. Lemström, Ann. der Physik, No. 8, 1901.

INDUCTION COILS.—The largely-increased demand for induction coils in consequence of the discovery of Röntgen rays has led to their more careful study by physicists and manufacturers. F. Klingelfuss has, as the result of such study, been enabled to produce considerably improved patterns. Two coils may be advantageously placed side by side, with the iron cores joined at one end and nearly joined at the other, leaving, however, an air space of 1 cm. between, so as to obtain the maximum spark length. The latter, otherwise, increases directly as the number of windings. The insulation of the condenser sheets must be the better the smaller the number of windings of the secondary coil with which a given spark length is to be obtained, since the primary extra-current, with the same magnetizing current and the same capacity in the condenser, assumes a higher E.M.F. the smaller the number of secondary windings. There is no direct ratio between the length of a spark and its E.M.F., since much depends upon the form of discharge and the resistance of the gas. It is even possible for sparks of the same length and the same apparent thickness to have different E.M.F.'s.—F. Klingelfuss, Ann. der Physik, No. 8, 1901.

SELECTED FORMULÆ.

Soluble Extracts of Ginger Ale.*—The frequent calls in the drug journals for practicable working formulas for soluble extract of ginger ale are witness to the fact that the retail druggist realizes that he can make this preparation for use at his soda fountain quite as well as the large manufacturers, and thereby save the difference between the cost of materials, which is but nominal, and the somewhat exorbitant price of the finished extract. Other druggists, who manufacture flavoring extracts, are frequently called upon by bottlers for a stronger ginger ale extract than that used at soda fountains, which shall be soluble, and shall produce no ropiness or cloudiness in the finished ginger ale.

The pungent principle of ginger is a resin, or resinous extractive, while the peculiar flavoring principle is a volatile oil. In the National Formulary extract, which is just one-half the strength of the fluid extract of ginger, U. S. P., the resinous principle is almost entirely precipitated, and this gives an extract of a delicate flavor, but of little pungency. It is next to impossible to obtain a soluble ginger extract in a more concentrated form than this, and still preserve the characteristic flavor. Modern manufacturers of extracts supply the wanting pungency with capsicum; and in the extracts which are to be used in the proportion of one ounce to a gallon of syrup, there is a minimum of ginger and a maximum of capsicum, cleverly disguised with other flavoring materials.

I give below three formulas; the first is intended for soda fountain use, the second is a "cheap" extract for the bottlers who want a one ounce to the gallon extract; and the third is a bottlers' extract to be used in the proportion of three ounces to a gallon of syrup. This latter is a most satisfactory extract, and has been sold with most creditable results, both as to clearness of the finished ginger ale and delicacy of flavor.

It will be noted that in these formulas oleoresin of ginger is used in addition to the powdered root. Those who do not mind the additional expense might use one-fourth of the same quantity of volatile oil of ginger instead. This should develop an excellent flavor, since the oil is approximately sixteen times as strong as the oleoresin, and has the additional advantage of being free from resinous extractive.

The following are the formulas:

SOLUBLE EXTRACT OF GINGER FOR SODA FOUNTAIN USE.

(To be used in the proportion of 4 ounces of extract to 1 gallon of syrup.)

Jamaica ginger, in fine powder	8 pounds
Capsicum, in fine powder.....	6 ounces
Alcohol, a sufficient quantity.	

Mix the powders intimately, moisten them with a sufficient quantity of alcohol, and set aside for four hours. Pack in a cylindrical percolator and percolate with alcohol until 10 pints of percolate have resulted. Place the percolate in a bottle of the capacity of 16 pints, and add to it 2 fluid drachms of oleoresin of ginger; shake, add 2½ pounds of finely powdered pumice stone, and agitate thoroughly, at intervals of one-half hour for twelve hours. Then add 14 pints of water in quantities of 1 pint at each addition, shaking briskly meanwhile. This part of the operation is most important. Set the mixture aside for twenty-four hours, agitating it strongly every hour or so during that period. Then take:

Oil of lemon.....	1½	fluid ounces
Oil of rose (or geranium).	3	fluid drachms
Oil of bergamot.....	2	fluid drachms
Oil of cinnamon.....	3	fluid drachms
Magnesium carbonate.....	3	fluid ounces

Rub the oils with the magnesia in a large mortar and add nine ounces of the clear portion of the ginger mixture to which has been previously added 2 ounces of alcohol, and continue trituration, rinsing out the mortar with the ginger mixture. Pass the ginger mixture through a double filter, and add through the filter the mixture of oils and magnesia. Finally pass enough water through the filter to make the resulting product measure 24 pints, or 3 gallons. If the operator should desire an extract of more or less pungency, he may obtain his desired effect by increasing or decreasing the quantity of powdered capsicum in the formula.

SOLUBLE EXTRACT OF GINGER ALE FOR BOTTLERS' USE.

(Formula No. 2, to be used in the proportion of 1 ounce to 1 gallon of syrup.)

Ginger, in moderately fine powder, 6	pounds
Capsicum, in fine powder..... 2½	pounds
Alcohol, a sufficient quantity.	

Mix, and moisten the powder with 3 pints of alcohol, and set aside in a suitable vessel for four hours. Then pack the powder firmly in a cylindrical percolator, and percolate until 6 pints of extract are obtained. Set this mixture aside, and label Percolate No. 1, and continue the percolation with 1½ pints of alcohol mixed with 1½ pints of water. Set the resultant tincture aside, and label Percolate No. 2.

Take: Oleoresin ginger, 5 fluid ounces, and add to Percolate No. 1. Then take:		
Oil of lemon.....	1½	fluid ounces
Oil of cinnamon.....	1	fluid ounce
Oil of geranium.....	½	fluid ounce
Magnesium carbonate.....	8	ounces

Triturate the oils with the magnesia, add gradually Percolate No. 2, and set aside. Then place Percolate No. 1 in a large bottle, add 3¼ pounds of finely powdered pumice stone, and shake at intervals of half an hour for six hours. This being completed, add the mixture of oils, and later 10 pints of water in quantities of ½ a pint at a time, shaking vigorously after each solution. Let the mixture stand for twenty four hours, shaking it at intervals, and then pass it through a doubled filter. Finally add enough water through the filter to make the product measure 24 pints, or 3 gallons.

SOLUBLE EXTRACT OF GINGER ALE FOR BOTTLERS' USE.

(Formula No. 3, to be used in proportion of 3 ounces in 1 gallon of syrup.)

Ginger, in moderately fine powder.. 8	pounds
Capsicum, in moderately fine powder 2	pounds
Alcohol, q. s.	

Mix: Moisten with alcohol, and set aside as in the preceding formula. Then percolate with alcohol until 10 pints of extract are obtained. To this add oleoresin of ginger 3 drachms, and place in a large bottle. Add 2½ pounds of powdered pumice stone, and shake as directed for Formula No. 1. Then add 14 pints of water in quantities of 1 pint at a time, shaking vigorously after each addition. Set the mixture aside for twenty-four hours, shaking at intervals. Then take:

Oil of lemon.....	1½	fluid ounces
Oil of geranium.....	½	fluid ounce
Oil of cinnamon.....	3	fluid drachms
Magnesia carbonate.....	3	ounces

Rub these in a mortar with the magnesia, and add

* Prize paper in American Druggist and Pharmaceutical Record. By John A. Foote, Washington, D. C.

9 ounces of the clear portion of the ginger mixture mixed with 2 ounces of alcohol, rubbing the mixture until it becomes smooth. Prepare a double filter, and filter the ginger mixture, adding through the filter the mixture of oils and magnesia. Finally add enough water through the filter to make the final product measure 24 pints, or 3 gallons.

If these formulas are properly manipulated the extracts should keep for a reasonable length of time without a precipitate. If, however, a precipitate occur, after the extract has stood for a week, it should be refiltered.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Wagon Roads in Palestine.—One of the greatest thoroughfares in Palestine is that between Jerusalem and Nablous, the ancient Shechem. For centuries it has been only a camel path, in many places rough and stony, and in spite of the vast amount of traffic it was not until 1900 that an effort was made to connect the two cities by a carriage road. Early in that year the route was surveyed and specifications sent to Constantinople, whence orders for the construction of roads must emanate. Work was begun the following autumn, and in March of the present year the first carriage passed over the completed section between Jerusalem and Bireh.

The extreme width of the roadbed is 19 feet 6 inches. After the grading, a bed of cracked stones 8 inches in thickness was made, over which earth was spread. The road was then well rolled. The grade is good, there being very few places where a horse cannot trot. I refer, of course, only to the completed portion between Jerusalem and Bireh. The culverts and small bridges on this section are twenty in number, with three additional bridges of fair size, the largest having two 50-foot arches, separated by 15 feet of solid masonry. These culverts are necessary to accommodate the small torrents created by the winter rains, which often do great damage.

From Jerusalem to Sinjil is a little over 19 miles, and from Bireh to Sinjil about 10 miles. The entire distance from Jerusalem to Nablous is 38½ miles. American travelers will remember Sinjil as their camping place the first night out of Jerusalem, going north toward Damascus. It is a curious fact that "Sinjil" is an Arabic adaptation of "St. Giles" of the Crusades, and "Bireh" is the Biblical "Beeroth" mentioned in Joshua ix., 17. Bireh has a good spring, and there has been talk of bringing water thence to Jerusalem.

The contract price for building the completed section of the road was about $23,000. There were only two bidders, both Christians (Armenians). Mohammedans and Jews do not engage in such work.

The distance between Bireh and Sinjil is only one mile greater than that between Jerusalem and Bireh, but the country is more rugged. There are many natural obstacles to be encountered, and the estimated cost of that section is from $40,000 to $44,000. Specifications have already been sent to Constantinople, and it is hoped this portion of the road will be built next year. The money will be raised in the Jerusalem district by a tax upon the peasantry. The Jerusalem district ends at Sinjil; what is north of that point comes under the jurisdiction of Nablous. This route is associated with many famous historical events, and the contiguous country contains the sites of the ancient cities of Nob, Gophna, Beeroth, Bethel, Ramah, Shiloh, etc.

The wagon roads already existing in Palestine are:

(1) Jerusalem to Yafa, 40 miles, begun in 1868, but a number of years elapsed before wagons could pass over it, and then only with difficulty, ten to twelve hours being required to go down to Yafa and fourteen to sixteen to climb back up the mountains. Thousands of tourists will remember the great discomforts of this trip. It was only in 1892, when the railroad between these two points became a certainty, that the Jerusalem and Yafa road was made fairly comfortable for carriages.

(2) Jerusalem to Hebron, 23 miles; completed in 1890.

(3) Jerusalem to Jericho, about 22 miles; completed in 1898. Ten years were spent in building this road.

(4) Jerusalem to the top of the Mount of Olives, about 4 miles; made in 1898 for the Emperor of Germany.

(5) Jerusalem to Bireh, 9 miles; just completed.

It is true that carriages go from Jericho to the Dead Sea and the River Jordan, but there is no road, the carriages driving where they please across the plain. Likewise wagons go along the roadless seacoast from Yafa to Haifa, at the foot of Mount Carmel, the road which was made for the Emperor of Germany in 1898 being entirely in ruins. Wagons also go from Yafa to Gaza, but no road was ever made there.—Selah Merrill, Consul at Jerusalem.

Chicle Gum in Mexico.—The so-called chicle gum of commerce is the sap that exudes from wounds made in the rough bark of the tree. This sap, of a milky whiteness and consistency when it first issues, partly coagulates after continued exposure to the air, but becomes, after boiling, a hard heavy mass. It is in this state that it is known to commerce.

The achras sapota (white sapota), known to the Maya Indians of Yucatan as "ya," is the tree that yields the milky sap. It is found growing all over Yucatan, sparsely in the north and west, but in belts of increasing size as one penetrates into the rich northeastern and southern section of the peninsula.

Under favorable conditions, the tree grows to a height of 70 feet or more. With its dark evergreen crown of glossy leaves, the tree is always a prominent landmark in the monotony of the surrounding forest. The fruit much resembles a russet apple in color and general appearance, but has a flavor wholly its own.

From May to June bands of men under experienced leaders get together their outfits and go into the deep forests of Yucatan as "chicleros." A chiclero is one who extracts the well-known Yucatan gum, or chicle, from the tree, and after several months of work in the tropical forest emerges with the large brick-like blocks of the hardened gum.

A rope, seven-eighths of an inch in diameter and 28 yards long, of special strength and make (for the life of the chiclero literally, as well as figuratively, depends upon it), a long heavy knife or machete of special make, pails for the crude sap, and ladles for dipping it are the articles of the individual outfit.

The general camp, or central station, where the chicleros gather at least once a day, contains, besides the usual paraphernalia of a large camp in the woods, large boiling kettles to cook the crude sap when brought in by the chicleros, box molds to shape the hardening gum after the cooking process, and scales with which to weigh the formed and dried blocks before it is placed to the credit of the chiclero. A large chicle camp in full operation, with its kettles of boiling sap and general air of industry, bears a certain resemblance to a northern maple-sugar camp.

The gum itself, as I have stated, is obtained by cutting canals in the rough bark, down which the sap flows into receptacles below. These canals, if cut by unskillful hands, may not only fail to extract the sap, but may ruin the tree as well. A healthy well-grown tree may be tapped once every three years, but even then, and under expert handling, at least 15 per cent of the trees will die.

Large tracts of sapota forests near Tuxpan, the original base of supply of the product, have become of late years practically unavailable from this cause. The average tree will yield about 6 pounds of gum, but often tree after tree, even in the most favorable season, will be tapped and not yield enough to pay for the work. Why this is so, no one knows, although every chiclero has his pet theory to account for it.

When the sap is collected, it is brought in pails and buckets to the central camp for boiling and molding. The boiling is done by practised hands, closely watched by vigilant inspectors. This vigilance is necessary to prevent the chicleros introducing foreign materials during the cooking. Stones of various sizes and often dirt are found in the center of the blocks, despite all care. The men are paid by the pound for the finished product and naturally wish to increase the weight. The gum when undercooked becomes quite hard, but contains a large percentage of water.

First-class well-cooked chicle is nearly white when fresh and clean. Red gum is produced when the gum is overcooked, though some trees yield a gum which has a distinctly red color, even when well baked.

The perfect chicle gum is tenacious, firm, aromatic, and very elastic. It is estimated that there are to-day 700 chicleros in the woods, and that the product this season may reach 1,000,000 pounds.

During the year 1900, 900,000 pounds of chicle were exported from the ports within this consular district. Ninety-eight per cent went to the United States; the remainder to France, England, and Germany.

The finest class of chicle, like the large hammock of Yucatan, is not known to commerce, being all required for home consumption.

This gum, called "sicte" by the natives, is produced by picking the unripe fruit of the sapota and collecting the thick drops of milky-white sap that accumulate in the wounds made therein.

The work of collecting the sicte is tedious and is generally done by the women, but the product is the perfection of chewing gum. It cannot be purchased for less than $1 a pound, and as a rule it costs more. It is highly aromatic, extremely elastic, and snow white.—Edward H. Thompson, Consul at Progreso.

Demand for Horses in South Africa.—Most of the horses and mules imported for army use into South Africa are purchased in the United States. Animals brought from other countries stand the climate well and require but little rest after landing before being put to work, but their lack of size and strength renders them unsuitable for farm and city use. The veldts of South Africa are dotted with carcasses of horses that have fallen by the wayside, overcome by fatigue, starvation or sickness. Mules are more hardy, especially American mules, which, owing to their size, strength, and adaptability to all kinds of work, are always in demand. Although many horses and mules have been imported into this colony during the war, many more will be needed. By the time hostilities have entirely ceased, there will be a dearth of these animals. Many farm horses have been commandeered, and those undisturbed by the military authorities are sadly in need of recuperation. There has been one sale by the authorities of horses and mules unfitted for army use. These animals were offered at a low price, with the object of benefiting the farmers who have suffered losses of live stock during the war. With a little care, many of them could be restored to health. The need of the army has been so urgent that many of the horses were not allowed sufficient time to recover from the effects of the ocean voyage before they were put to work. Horses that have become acclimated are said to be "salted." An American firm in this city has built up a large business in the sale of American horses and mules. Among its importations have been a number of excellent carriage horses. On arrival, the animals are allowed to rest, are well taken care of, and generally become acclimated without suffering. The company owns commodious stables at Cape Town.

After the war is over the opportunities for business in this line will be greatly increased, not only in Cape Colony, but in the Transvaal, the Orange River Colony, and Natal. Cape Town is a good place at which to land and care for stock before shipment elsewhere. Prices are, and will continue to be, satisfactory.—James G. Stowe, Consul-General at Cape Town.

American Engines in Glasgow.—Consul Taylor, of Glasgow, July 26, 1901, writes in regard to recent newspaper attacks on the American engines used by the Glasgow tramways. It is asserted that the engines, at the opening of the Exposition, were incapable of running; that later, when tried with a light load, they broke down through the bearings becoming overheated, and that they were generally unsatisfactory. The Consul says:

These assertions were never warranted by complaints emanating from those who had supervision of the tramways. I have the very best authority for saying that not only have the American engines fulfilled, but they have exceeded, expectations. Mr. H. F. Parshall, the consulting engineer, reports to the Tramways Committee of the Town Council:

"The little trouble at first experienced from warm pins with the Allis (i. e., American) engines has entirely disappeared. No. 1 Allis engine has now been carrying the carload for eleven days and No. 2 for sixteen days. The average load on an engine for 250 cars amounts to some 1,400 K. W. The average output from the station amounts to 0.93 Board of Trade units per car mile, which figure will indicate to you that the system generally is working efficiently and well. As regards the Musgrave engines, the first commenced turning round on Monday last. There have been some incipient troubles from heating, but not more than might reasonably be expected in starting a new engine. The engine will be first put on artificial load on Saturday, provided things go on satisfactorily, and it is expected it will be in satisfactory working order for carload in a week from that time."

The "incipient troubles from heating," mentioned in this report as affecting the Musgrave engines, were the same as met with at first in the Allis engines, and were eagerly seized upon by interested parties who wished to advertise that the Allis engines were failures. In a conversation with one of the managers of the road, I was given the history of the trouble, which I quote almost verbatim:

"The Allis engines did not really have a fair chance at first. The 24th of April—the day on which the tramway system was formally opened—was the first day on which they were set going. The system was formally opened that day, but the tramways did not commence running till April 27. It was not deemed advisable to put the full load on the Allis engines on the 27th, and they did ultimately break down. This was not surprising, as they were wholly untried engines, and it was scarcely reasonable to expect that they should be perfection on first asking. The cause of the breakdown was very trifling; it was caused by the bearings becoming overheated, due to a defect in the lubricating arrangements. It was about a month afterward before the Allis engines could supply all the power to operate the tramways. After that time the power for the whole system was provided by them. They have not since broken down in any shape or form, and from the time they were properly started, they have given every satisfaction and continue to do so. They have come quite up to the best expectations formed of them; in fact, they have surpassed anticipations. As they have not been officially tested yet, it is perhaps premature to give any opinion regarding their real merits; but so far as their connection with the operation of the tramways is concerned, they have done splendidly."—Samuel M. Taylor, Consul at Glasgow.

Exposition of Fisheries at St. Petersburg.—The Department has received from the Russian Embassy, Washington, under date of August 12, 1901, notice of the International Exposition and Congress of Fisheries, to be held in St. Petersburg in 1902. An invitation is extended to the United States to participate in the exposition and to send official delegates and experts to the congress. Programmes of both are inclosed.

The following extracts are taken from the regulations:

The exhibition is open to Russian and foreign exhibitors. Its objects consist in: (*a*) Determining the actual condition of sea and fresh-water fisheries, and of other similar pursuits; (*b*) acquainting producers and consumers with the various products of fisheries and with methods of preparing and preserving the same; (*c*) exhibiting the gradual development and actual state of artificial fish breeding, as likewise the various aspects of amateur fishing and angling; (*d*) promoting scientific research pursued in the interests of fisheries.

Applications for space are to be addressed to the Executive Committee, 13 Bolshaya Konushennaya, St. Petersburg, in duplicate, before November 1, 1901.

Exhibits will be carried on Russian railways at a reduced rate. The exhibition will be proclaimed a bonded store for foreign exhibits. Duties will be charged on goods remaining in Russia.

Preparation of Haitian Coffee.—Under date of July 29, 1901, Minister Powell, of Port au Prince, sends translation of a circular issued by the President of Haiti to the commandants of different districts, inviting attention to the bad condition in which Haitian coffee comes to market, and attributing its depreciation in price largely to this fact. Coffee being the principal article of exportation, the circular urges that cultivators give special care to the preparation of this bean, in order to compete successfully with other coffees in foreign markets.

Leipzig Exhibit of Wearing Apparel.—Consul Warner, of Leipzig, under date of July 11, 1901, says:

The exhibition of wearing apparel which will be held here from the 14th to the 30th of September will give an opportunity of reviewing the clothing industry in all phases. The exhibition will be divided into the following departments: (1) Hygienic dress; (2) art dress; (3) general modes; (4) finery; (5) sewing and embroidery machines, etc.; (6) fashion journals, trade papers, fashion plates, and books. The headquarters of the exhibition is at the "Moden Akademie," Theaterplatz 1, Leipzig, where further information can be obtained.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1134, September 9.—*German Wine Industry—*An Immigration Scheme in Honduras—Drying Wood by Electricity in Austria—*American Fire Brick in Ontario—*The Yangtze Floods—*Iron Sands of Guadeloupe.

No. 1135, September 10.—*Rubber Culture in Nicaragua—Japanese-Chinese Commercial Relations—Venezuelan Tariff on Corn and Beans—Tariff at Vladivostok.

No. 1136, September 11.—*Chambers of Commerce in Foreign Countries—New Method of Propelling Small Vessels—Electric-Railway Project at Carlsbad—Petroleum in New Brunswick.

No. 1137, September 12.—American and English Locomotives in Japan—Brazil-United States Steamship Syndicate—*Sugar as Food—Korean Rice Exports Prohibited—Beginning of Montevideo Port Works—Trade Treaty between Germany and Salvador.

No. 1138, September 13.—Indian Corn in Belgium—Hats in Mexico—Mexican-United States Steamship Concession.

No. 1139, September 14.—The Waste-Heat Auxiliary Engine—Steam Navigation on the Rivers of Tabasco—German Duty on Emery Wheels.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Imitation of Burnt, Colored Enamel Goods.—For this purpose pigments ground with a fat, hard-gum varnish can be employed. According to whether more or less time is to be expended for the preparation of the imitations, the varnish colors are either applied several times in thin layers, allowing to dry each time, rubbing down, and lacquering with copal lacquer or else a thickly-liquid varnish paint is applied once and allowed to dry.

The composition of suitable varnish paints is as follows:

BLUE.

Pale copal varnish	5 parts
Zinc white	1 part
Ultramarine blue	2 parts
Pale copal varnish	10 parts
Zinc white	2 parts
Paris blue	3 parts

GREEN.

Copal varnish	2 parts
Chrome green	1 part
Copal varnish	10 parts
Zinc white	3 parts
Zinc green	5 parts

BROWN.

Copal varnish	2 parts
Prussian brown	1 part
Copal varnish	5 parts
Vandyke brown	1 part

RED.

Pale copal varnish	10 parts
Vermilion	3 parts
Red lead	3 parts
Pale copal varnish	2 parts
Vermilion	1 part
Pale copal varnish	2 parts
Indian red	1 part

YELLOW.

Pale copal varnish	2 parts
Chrome yellow	1 part

BLACK.

Copal varnish	6 parts
Ivory black	1 part

GRAY.

Copal varnish	20 parts
Zinc white	12 parts
Lamp black	1 part

WHITE.

Limpid copal varnish	6 parts
Krems white	5 parts

A little ultramarine blue.

REDDISH BROWN.

Burnt and levigated sienna	2 parts
Copal varnish	5 parts

—Deutsche Goldschmiede Zeitung.

Recipes for Label Paste.—1. Stir 5 parts rye flour together with 1 part of Venice turpentine, adding enough size (glue water) so that a paste results. This paste dries very slowly; the paper labels pasted on with it adhere very firmly, even to all sorts of metals.

2. Gum arabic 50 parts, glycerin 10 parts, water 30 parts, Liq. Stibii chlorat. 2 parts.

3. Boil rye flour and strong glue water into a mass to which is added for 1,000 parts, good linseed oil varnish 30 parts, and oil of turpentine 30 parts. This mixture furnishes a gluing agent which, it is claimed, even renders the labels proof against being loosened by moisture.

4. Dissolve dextrin 2 parts and acetic acid 1 part in water 5 parts by heating in a water bath, and add 1 part of alcohol to the mixture.

5. Pour 140 parts of distilled cold water over 100 parts of gum arabic in a wide-necked bottle and dissolve by frequent shaking. To the solution which is ready after standing for about 3 days add 10 parts of glycerin; later 20 parts of diluted acetic acid, and finally 6 parts of aluminium sulphate, then straining it through a fine hair sieve.

6. Dissolve 50 grammes of joiner's glue, previously soaked in cold water, with 100 grammes of powdered rock candy and 25 grammes of powdered gum arabic in 200 grammes of water, and boil until the mass is thinly liquid.

7. According to another receipt good glue is said to be obtained by dissolving 1 part of powdered sugar in 4 parts of soda water glass.

8. A reliable glue for bottle labels is prepared by dissolving borax in water; soak glue in this solution and dissolve the glue by boiling. Carefully drop as much acetic acid into the solution as will allow it to remain thin on cooling. Labels, affixed with this agent, adhere firmly and do not become moldy in damp cellars.

9. Dissolve 250 grammes of gum arabic (finely powdered) in 500 grammes of boiling water, add 750 grammes of glucose and boil for a while with stirring. After removal from the fire admix 30 grammes of acetic acid.—Zeitschrift für die gesammte Kohlensäure-Industrie.

Process for the Production of Almost Odorless Tar Preparations Soluble in Water.—The varieties of tar chiefly entering into pharmacy are especially the officinal pine tar, also *Oleum Rusci* and *Oleum Cadinum*. Useless in medicine owing to their unpleasant odor and their insolubility in water are brown coal tar, as well as other varieties of tar deficient in phenol and obtained by the distillation of bituminous shale.

Knoll & Company, of Ludwigshafen, have found that these drawbacks can be obviated by subjecting the wood tar for a short while to the action of concentrated sulphuric acid at about 100 deg. C. The strong-smelling constituents of the wood tar are thereby modified in such a manner that after washing the sulphuric acid out with water and subsequent solution of the pulverulent reaction-product in alkali an almost odorless preparation is obtained.—Pharmaceutische Centralhalle.

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TABLE OF CONTENTS.

PAGE

I. ASTRONOMY.—The Observatory at Nice.—4 illustrations 21526

II. CIVIL ENGINEERING.—A Curious Suspension Bridge.—By H. C. TYRRELL.—3 illustrations 21529

III. COMMERCE.—American Competition in Austria-Hungary 21531
Trade Suggestions from United States Consuls 21533
Exports of Boots and Shoes 21535

IV. EDUCATION.—The Functions of a University 21527

V. ELECTRICITY.—Contemporary Electrical Science 21531
Mechanism of the Santos-Dumont Balloon.—2 illustrations 21532
The Presidential Address of Joseph Wilson Swan, F.R.S., at the Glasgow Meeting of the British Association.—Electro-Chemical Industry 21530

VI. FORESTRY.—The African Forest.—By GEORGE L. BATES 21536

VII. FUELS.—The Utilization of Blast Furnace Gases 21532

VIII. INSECTICIDES.—The Use of Hydrocyanic Acid Gas for Exterminating Household Insects 21535

IX. LOCOMOTIVE ENGINEERING.—American Locomotives in England.—IV 21523
American Locomotives in Europe 21524

X. MECHANICAL ENGINEERING.—The Crompton Ash Hoist.—1 illustration 21532

XI. MISCELLANEOUS.—Selected Formulæ 21531
Trade Notes and Receipts 21534

XII. STEAM ENGINEERING.—Locomotive Water Gage.—2 illustrations 21533

XIII. TECHNOLOGY.—About Shoe Polishes 21535

XIV. TEXTILES.—Oriental Rug Weaving.—4 illustrations 21539

XV. WARFARE.—The Future Coaling Stations of the United States.—1 illustration 21525

XVI. YACHTING.—The Comic Side of Yachting.—9 illustrations 21527

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PAGE
21526
21530
21531
21533
21535
21537
21538
21539
21540
21542
21545
21546
21547
21548
21549
21550
21551
21552
21553
21554
21555
21556
21557

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